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O. P. BRYSCH, Editor — P. J. CHATTA, Assistant Editor

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1. MANAGEMENT

Gas Industry Expansion

FPC Atmosphere Favorable as Hearings Open on $340 Million, 1400 Mile Canada-U.S. Line. J. Huttlinger. *Pipe Line News 31,* 24 (1959) Nov. (3 pp.)

Another project to bring Canadian natural gas as far as San Francisco may receive the blessings of U.S. and Canadian authorities within the next year. Leader in the project is the Pacific Gas & Electric Co. which has set up a subsidiary in Alberta to buy gas and another to carry the gas from the U.S.-Canadian border at Kingsgate to Klamath Falls, Ore. Program would enable the delivery of 450 MMCF/day of gas at the southern end, Antioch, Calif. Pacific Gas Transmission Co., a subsidiary of PG&E, proposes to construct 614 miles of 36-in. transmission line plus related facilities at a cost of $129,588,000. Alberta Gas Trunk Line Co. Ltd. proposes 386 miles of transmission line and related facilities to cost $69,217,000 in Canada. Some 256 miles would be 36-in., 75 miles would be 30-in., and 55 miles would be 26-in. Alberta Natural Gas Co. proposes 108 miles of transmission 36-in. main, to cost $37,664,000. PG&E proposes 296 miles of 36-in. transmission main to cost $63,930,000.

Gas Industry Management

Harris Names Terms for New Gas Bill. *Oil Gas J. 57,* 125 (1959) Nov. 16.

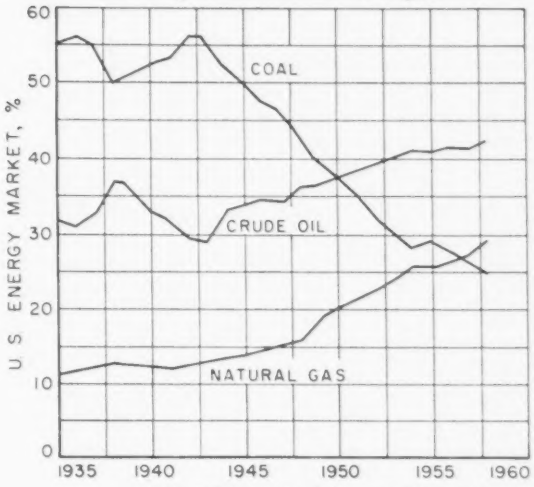
Report of an address by Rep. Oren Harris, Arkansas Congressman and chairman of the House Committee on Interstate and Foreign Commerce, delivered before the American Petroleum Institute's Division of Transportation. In his speech he laid responsibility for action on a bill to clarify gas-industry regulation upon the White House. His stand: The administration from the top must speak out forthrightly and urge its enactment.

Research

Research in the Gas Industry. H. Smith. I.G.E. Communication No. 555. *Gas World 150,* 611 (1959) Nov. 21 (4 pp.); **Research: Keystone of Progress in the Gas Industry.** *Gas J. 300,* 362 (1959) Nov. 25 (2 pp.)

Author reviews historically the research efforts of the British gas industry, beginning with the establishment of the inventions investigation fund in 1879, which subsequently became the research fund. By 1881 enough interest had been generated to establish an investigation and research committee under the control of the general committee of the British

Primary Fuel Market Changes



(Adapted from *Coal Aims to Undermine . . .*
See Abstract, P. 388)

Association of Gas Managers. In 1884, the Gas Institute undertook an investigation into Standards of Light, and in 1904, the Institute merged with the Institution of Gas Engineers. In 1939, the Gas Research Board was formed, and when the industry was nationalized in 1949, the conduct of research became one of the specific duties placed on the Gas Council by the Gas Act, 1948. Research by the Council has five main objectives: 1) To improve existing processes for the manufacture of gas and coke and recovery of byproducts; 2) to develop new processes for the manufacture of gas from coal and oil, particularly at high pressure; 3) to develop more efficient methods of purifying gas and recovering byproducts; 4) to improve existing appliances and to develop new appliances for use by domestic and industrial consumers, and 5) to obtain fundamental knowledge of the properties of gases and the mechanism of combustion and flame propagation.

Federal Power Commission

How the FPC Approves Pipeline Construction. J. Huttlinger. *Pipe Line News 31,* 58 (1959) Nov. (3 pp.)

In view of the increasing rate of activity at the Federal Power Commission (FPC) author presents a special review of how a gas company obtains a construction certificate from the FPC. Basic rule is that applications must be in the form of an original and seven copies and must contain such general information as name, address and corporate structure of the company; all facts needed to show the project "is or will be required by the present

or future public convenience and necessity"; brief outline of the company's present operations; brief outline of the proposed project complete with dates proposed to start and complete the project, and a set of Exhibits from A through P (defined by author).

Ratemaking

The Public Interest in Interruptible Gas Sales. C. L. Dunn. *Gas Age 124,* 22 (1959) Nov. 26 (6 pp.)

Economy of high load factor operations, essential to economic service to both firm and industrial customers, cannot be achieved, according to author, unless pipeline rate structures permit competitive interruptible sales. Consequently both pipeline and distribution companies must be vigilant to see that regulatory orders are based upon sound economic analysis rather than upon convenient compromises applicable only to special situations.

Drilling

Cost Figures of 45 Contractors Show Electric Drive Cuts Rig-Upkeep Expense. J. T. Ragan. *Oil Gas J. 57,* 74 (1959) Nov. 30 (3 pp.)

Electric drive for oil well drilling rigs can reduce drawworks and transmission system maintenance costs as much as 52%. In specific instances, savings have been higher. Downtime attributable to transmission difficulties can be reduced by as much as 75%. These cost savings, and others, add up to a maintenance-cost ratio of 8:1 in favor of electric drive. Figures used in article are based on a study of 125 rigs, and some 28,000 days of rig operation. Cost comparisons are limited to operating cost factors which are a direct function of the type of transmission used.

Pipeline Systems

Humble's King Ranch—Clear Lake Line. F. H. Love. *Pipeline Eng. 31,* D-23 (1959) Dec. (4 pp.)

When Humble Oil & Refining Co. finished laying a 238-mile, 30-in. natural gas pipeline from Southwest Texas to the Houston area in September, it completed a part of a $70,000,000 gas project that was begun last year. Over-all, the project includes the new 238-mile line, several gathering systems, and a gas processing and cycling plant on the King Ranch in Kleberg County. The 30-in. line will tie in with the 78-mile line completed last year from Clear Lake to the Port Arthur area. Purpose of the project is to utilize gas from a number of Southwest Texas fields. The processed gas from the plant will be used for cycling and pressure maintenance in various fields and reservoirs and to supply industrial customers in the Corpus Christi, Houston and Port Arthur-Beaumont areas.

Foreign Activities

Piacenza. The Safety of Gas Plants Distributing Gas for Domestic Use. D. Ciuffolotti. *Gas World 150,* 636 (1959) Nov. 21 (3 pp.); **The Domestic Utilization of Natural Gas.** I. Giordano. *Ibid.,* 636 (1959) Nov. 21 (3 pp.); **Technical Problems in the Conversion of Equipment for Use with Natural Gas.** M. P. Delburg. *Ibid.,* 636 (1959) Nov. 21 (3 pp.)

Problems associated with the transportation and utilization of natural gas provided the theme of an international technical-economic conference on hydrocarbons held recently in Piacenza, Italy, in the course of which some 300 experts from Austria, France, Germany, Holland, Italy, Iran, Sudan and other countries met to work out the statute of the recently-instituted Permanent European Centre of Information on the Utilization of Natural Gas and other Gaseous Hydrocarbons which is to have its headquarters there. The aims of this center are to promote the utilization of natural and petroleum gases, research into problems associated with this and to provide for contacts and exchange of information with other similar European or international institutions. In the course of the conference, reports were presented covering general and particular aspects of the main theme. Among them were three of special interest. Article reviews highlights of these.

Continental Uses of Gas in Industry. T. Ward. I.G.E. Communication No. 561. *Gas World 150,* 617 (1959) Nov. 21 (3 pp.)

Discussion of the second Dempster Fellowship which was awarded to enable a study of the industrial uses of gas to be made in Germany, Holland, Belgium, France and Italy. In the five countries visited, gas was used in many ways, and a great volume of information was amassed in the 185 factories visited. Abridged version of a more detailed report gives impressions and information gained during a four-month visit to these countries.

Technical and Manpower Problems Being Encountered in Laying Sahara Pipeline. F. H. Korn. *Pipeline Eng. 31,* D-19 (1959) Dec. (4 pp.)

Discovery of the Edjele field by the Compagnie de Recherches et d'Exploitation de Petrole au Sahara (CREPS) in 1956 was the first Saharan discovery. It has been followed by several others. The problem of transporting the oil produced is being solved with the construction of a 24-in. diam pipeline 780 km (485 miles) long. This line will carry 150,000 bbl/day when it begins operating in 1960. Optimum capacity will be approximately 340,000 bbl/day. Starting point of the pipeline is on the tableland of Zarzaitine in In Amenas, a central location in the

CREPS oilfields. From here it proceeds northward in a straight line to the Libyan town of Ghadames, which it bypasses before crossing the Tunisian border at 280 km (174 miles) from its point of origin. In Tunisia the line curves eastward and follows the Libyan border to Mechiguig. Here the pipeline goes around the Grand Erg Oriental and continues northward, bordering the 10-degrees Meridian, to its terminus on the Mediterranean at La Skhirra, approximately 80 km (49.7 miles) southwest of Sfax and 55 km (34 miles) north of Gabes.

The Desert Blooms. E. Adams. *Pipeline Eng. 31,* E-1 (1959) Dec. (8 pp.)

Libya, a new kingdom in North Africa, attracts operators by its sane laws, and inviting discoveries keep them searching across the arid country. What was once among the world's poorest nations is being transformed by a modern geni—petroleum. Article presents, in tabular form, discoveries, in tabular and diagram form, concessions, describes the drilling practices employed by various companies, and discusses exploration difficulties, labor and marketing.

Petrochemicals

Petrochemical Handbook. *Petrol. Refiner 38,* 183 (1959) Nov. (122 pp.); **Over-all Outlook.** R. L. Bateman. *Ibid.,* 189 (2 pp.); **Synthetic Detergents.** F. Dee and C. T. Snell. *Ibid.,* 191 (2 pp.); **Pesticides.** M. Goldberg. *Ibid.,* 192 (2 pp.); **Synthetic Fibers.** D. W. Chaney. *Ibid.,* 193 (2 pp.); **Plastics.** A. F. Sward. *Ibid.,* 194 (3 pp.); **Aromatic Hydrocarbons.** L. G. Parkinson. *Ibid.,* 196 (2 pp.); **Olefins.** C. H. Thomas. *Ibid.,* 197 (2 pp.); **Fluorochemicals.** J. P. Farrell. *Ibid.,* 198 (2 pp.); **Synthetic Rubber.** J. D. D'Ianni. *Ibid.,* 199 (2 pp.)

In spite of three very real and pressing problems, the petrochemical industry still is showing remarkable growth and staying power. Three problems are overcapacity, shrinking profits and foreign competition. First eleven pages of the handbook are devoted to over-all outlook for petrochemicals in general and outlook for some of the specific classifications. Detailed descriptions of some 190 processes and processes of 42 manufacturers comprise the remainder of the handbook.

Customer Service

Gas in the Domestic Field. F. J. Eaton. *J. Inst. Fuel 32,* 531 (1959) Nov. (8 pp.)

British gas industry, in the postwar period, and possibly to a greater extent since nationalization, has adopted a three-way approach in the development of gas domestic service. First, by market consumer research, and field tests to determine the pattern of domestic fuel usage; this may be termed the sociological approach. Second, to develop improved appliances and heating systems to suit the householders' requirements—this is mainly technical—and third, to devise purchasing arrangement, favorable tariffs and other commercial matters so that the service is provided at an economic and competitive price. This three-way approach is illustrated in the article by reference to cooking, water heating and space heating, and is prefaced by a brief review of the factors affecting the pattern of domestic fuel usage.

A Guide to Training Servicemen. Part 6. How to Deal with Absorption Refrigeration. G. R. Thompson. *Gas 35,* 79 (1959) Dec. (5 pp.)

Article describes training given to employees of Washington Gas Light Co. during their first four years in the service department. Outline of the course on gas-fired absorption refrigeration is included.

Safety

Fires and Losses Classified, 1958. *Quarterly Nat. Fire Protection Assoc. 53,* 162 (1959) Oct. (8 pp.)

There were approximately 1,993,575 fires of all types in the U. S. in 1958, causing a loss of $1,278,808,000, according to estimates compiled by the National Fire Protection Association. The 1958 loss was a slight decrease from that of 1957 when the estimated loss was $1,279,926,000. The 1,993,575 fires in 1958 were 31,925 fewer than in 1957. Detailed breakdown is included.

How Gas Can Help the Industrialist to Meet Requirements of Current Legislation. W. F. Howell. *Gas J. 300,* (Gas in Ind. Sect.) 262 (1959) Nov. 4 (6 pp.)

British gas industry is aware of its responsibility with regard to the safety aspect of gas installations. The closest cooperation is maintained between the Industrial Gas Development Committee and the appropriate personnel of the Factory Department of the Ministry of Labor to insure that the most suitable practicable safeguards for gas installations are recommended. In this connection mention is made of the Committee's review of flame protection practice and the work by the Midlands Research Station on explosion reliefs. The principal Acts dealing with safety, health and welfare in industrial premises are the 1937 and 1948 Factories Acts.

A Process Can Be Immune from Detonation—but—. O. A. Pipkin. *Oil Gas J. 57,* 149 (1959) Nov. 16 (5 pp.)

Analysis of the explosion at the Ponca City, Okla., refinery of Cities Service Oil Co. on January 22, 1959, leads to these conclusions: 1) Detonation can occur in any process where air is present, through faulty purge procedure or any other cause, assum-

ing the existence of other contributory conditions; 2) startups continue to be the most vulnerable period of any operation; 3) startup procedure of old units should be reviewed with reflection on the latest technology. Each addition or deletion to a startup procedure should be studied thoroughly for even the remotest combination of circumstances which might result in hazardous conditions.

Fatal LP-Gas Tank Truck Fire. C. F. Jones. *Quarterly Nat. Fire Protection Assoc. 53,* 89 (1959) Oct. (9 pp.)

Report of a 7000-gal LPG tank truck fire that killed 11 spectators and injured 10 others. It is pointed out that in case flame impinges on the tanks, in the absence of cooling by hose streams there is nothing in present tank design to prevent pressure rupture or explosion at a time when the contents have evaporated and the tank shell is weakened by heat.

Detonative Explosions Need More Close Industry Study. R. B. Jacobs. *Oil Gas J. 57,* 145 (1959) Nov. 16 (4 pp.)

Not too much is known about conditions under which detonations occur, but it is believed that almost all flammable gaseous hydrocarbon-air mixtures can detonate, and also that flammable hydrocarbon mists in air will detonate. Three characteristics of the detonative explosion that make it particularly destructive are: 1) It produces a peak pressure which may be as much as 20 times the peak pressure produced by a normal explosion; 2) the detonation front travels at supersonic velocities, which makes pressure-relieving devices useless for the most part, and 3) the detonation exerts a directed blow rather than a hydrostatic force. This directed blow is often particularly damaging.

2. ENERGY SUPPLY AND ECONOMICS

Gas Production

In an Alberta Field . . . Operators Prefer Gas over Oil. *Petrol. Week 9,* 33 (1959) Dec. 4 (2 pp.)

Operators in Alberta's (Canada) Homeglen-Rimbey field are asking the Oil and Gas Conservation Board to reclassify it as a gas field with oil as "a valuable byproduct." To get maximum oil production, the operators say, would necessitate the permanent shut-in of the field's large gas reserves, which are much more valuable. They champion a method calling for gas deliverability of 65.2 MMCF/day until Oct. 31, 1961; 71.8 MMCF/day for the following year, and a peak rate of 120 MMCF/day thereafter. It is believed that this plan also would boost total oil recovery over the present method by 1.2-2.2 million bbl. A thick gas cap—280 ft—and a thin oil sand—24 ft—are the factors which make it difficult to obtain good oil production from the 12-mile-long field. The outcome of this issue, in which a decision is expected soon, will set a precedent in Alberta.

Gas Reserves

Five New Gas Outlets to U. S. *Business Week 1580,* 110 (1959) Dec. 12 (2 pp.); **Canadian Gas-Export Picture Looks Brighter.** *Oil Gas J. 57,* 75 (1959) Dec. 7.

First act of Canada's National Energy Board will be to open hearings on January 5, 1960, on five gas export applications, one of which has been on file since 1955. If the new board approves, Canada will export another 880 MMCF/day for the next 20 or 25 years. The five projects that will receive consideration are: 1) Trans-Canada Pipe Lines, Ltd., of Calgary and Toronto, to export 204 MMCF/day through Emerson, Manitoba to Midwestern Transmission Co.; 2) Westcoast Transmission Co. of Calgary, to export 165 MMCF/day to Pacific Northwest Pipeline Corp. from the Peace River field via Kingsgate, B. C.; 3) Alberta & Southern Gas Co., to export 459 MMCF/day through Kingsgate; 4) Canadian-Montana Pipe Line Co., to export 36 MMCF/day to its parent Montana Power Co., and 5) Niagara Gas Transmission Ltd. to export 16.7 MMCF/day.

Coal

Coal Aims to Undermine Oil's Markets. *Oil Gas J. 57,* 41 (1959) Dec. 14 (2 pp.)

National Coal Policy Conference, organized last spring by the coal industry and allied interests, has already drawn clear-cut lines of attack for its campaign to win markets at the expense of oil and gas. Its members include coal operators, the United Mine Workers, coal-carrying railroads, coal-burning utilities, and the manufacturers of coal-mining equipment. Its objective is to promote the interests of the bituminous coal industry. It has already launched a vigorous, apparently well-financed, campaign to win public and government approval of policies which would help the industry become more competitive.

Peak Loads

Considerations of Operating Management on Replacing Gas Production from Coal with LP-Gas Cracking. R. Schreiber. *Gas- u. -Wasserfach 100,* 1172 (1959) Nov. 6 (3 pp. German text.)

Difficult situation in the coke market has allowed new processes of city gas production without coke formation to enter the field of interest. For average gasworks, LPG cracking is such a suitable process without coke production. By far the greatest portion of

gas production costs is constituted in the expense for crude energy, for coal carbonization in the so-called coal residue costs, and for LPG cracking in the expense of injected butane. In planning conversion to LPG cracking, the primary interest is the coke price limit or the selling price of coke as compared with raw energy costs of LPG. These are set up as formulas and discussed, and costs of the coke route or gas route, as well as regional locations, are determined for a specific plant. Use of LPG seems favored usually, although other factors besides crude energy costs, such as capital cost, operating charges, retirement rate, flexibility, ground area, etc., also have influence.

Petroleum Reserves

Panel Will Defend 27% Depletion. *Oil Gas J. 57,* 102 (1959)Nov. 9 (2 pp.)

House Ways and Means Committee is conducting a broad, lengthy study of taxes in general, seeking to determine whether the over-all tax base could be broadened—thereby permitting a reduction of some taxes—to strengthen and stimulate the nation's economy. Copies of all the papers being presented for the study are being published and can be obtained by writing to The Ways and Means Committee, House of Representatives, Washington 25, D. C.

What's Happening to Oil Industry Dollars? *World Oil 149,* 94 (1959) Nov. (5 pp.)

Five oil industry cost studies, completed in the last twelve months, indicate: Average value of one million Btu's of crude oil and natural gas at the wellhead has increased only 4% since 1948, while the increase in average cost of exploration, development and production has risen approximately 62%—and there is no evidence of any decline in this trend through 1959. Following present trends, drilling costs could average $16.39/ft in 1960, $20.11 in 1965 and $24.38 in 1970—nearly 70% higher than in 1957. If present margins between average cost per barrel of replacement crude oil are used, the average price of crude oil would be $3.30 in 1960, $4.35 in 1965 and $6.50 in 1970.

How to Save with Applied Technology. *World Oil 149,* 101 (1959) Nov. (6 pp.)

Domestic petroleum industry is being squeezed between two powerful and opposing sets of economic forces: Steadily rising costs and downward pressures on prices arising from the abundance of crude oil in the Free World markets, coupled with low cost natural gas. Top oil company, industry association and government sources believe that applied technology can help cut industry costs in seven areas: 1) Sizing of lease and well equipment; 2) lease and well operations; 3) remedial well work; 4) recovery projects; 5) well spacing; 6) exploration methods and equipment, and 7) research.

How One Company Determines Cost. R. E. Megill. *World Oil 149,* 107 (1959) Nov. (4 pp.)

Results of current exploration programs can be determined only by considering the new reservoirs found during the period. Finding expenses should be related to the barrels of oil found in these reservoirs. Determining the proper barrels to relate to current costs necessitates adding to current reserve data an estimate of future reserve additions. Following is the method used to estimate reserves in the analysis: 1) All petroleum reservoirs are separated by year of discovery; 2) current estimates of reservoirs are tabulated by year of discovery, and 3) current estimates are statistically corrected for the future. This method adjusts the barrels found and developed to a probable final basis.

Iranian Consortium Pushing Wildcat Operations. P. Swain. *Oil Gas J. 57,* 116 (1959) Nov. 9 (2 pp.)

Iranian Oil Exploration Co. soon will have wildcat rigs spread for more than 600 miles in a crescent along Iran's Persian Gulf. One of these rigs recently established a new field near Ahwaz on a structure that has defied efforts to make it yield oil for the past 40 years. One is testing one of Iran's largest surface structure, 8 miles wide and 65 miles long, at Kuh-i-Mund. Another soon will test a structure farther south than any deep test yet drilled in Iran. Three of these four are looking for Cretaceous oil at greater depths than the Asmari limestone which is productive in all Iran's producing fields.

Refinery Expansion in Europe. T. H. H. Skeet. *Petrol. 11,* 381 (1959) Nov. (4 pp.)

Expansion in demand, actual and prospective, has led to expansion of refinery capacity in Western Europe, and while prior to the war Europe imported crude oil and petroleum products roughly in the proportion of 25% and 75%, respectively, the figures have since been very largely transposed. Petroleum products now imported account for only 15% of requirements, while crude for treatment in European refineries has advanced to 85%. Article includes tables on ownership by nationality of refinery capacity, company ownership of refining capacity and growth of refinery capacity by state.

Energy Sources

How to Select Your Drive System. W. B. Wilson and I. H. Landes. Part 1. *Oil Gas J. 57,* 113 (1959) Dec. 7 (6 pp.); Part 2. *Ibid.,* 76 (1959) Dec. 14 (4 pp.)

In 1955 and 1956, the latest two years for which published data are available, the chemical and petro-

leum industries spent over $2 billion for their purchased fuel and electric power requirements. This cost for energy is 15% greater than the total expenditure for new machinery and equipment during this same period. This fact should emphasize the importance of proper drive equipment.

Foreign Activities

India's Longest Pipeline Moves Ahead. *Oil Gas J. 57,* 60 (1959) Nov. 23 (2 pp.); **Work Starts to Tap New India Fields.** *Petrol. Week 9,* 42 (1959) Nov. 20 (2 pp.)

Pipe deliveries have started for a 720-mile crude pipeline to be constructed in northeastern India. The line will be built in two stages and will feed two new refineries. The first section will be a 260-mile, 16-in. line from Digboi in Assam to Nunmati in the same province where the first refinery will be constructed. The second section will be a 460-mile line running farther westward to Barauni in Bihar, where the second plant will be located. The system will deliver up to 15,000 bbl/day to the Nunmati plant and 40,000 bbl/day to Barauni.

Offshore Operations

Submarine Exploration for Oil. *J. Inst. Petrol. 45,* 263 (1959) Sept. (24 pp.); **Introduction.** C. N. Crosthwaite (3 pp.); **Geology.** S. Elder (4 pp.); **Geophysics.** A. B. Malone (4 pp.); **Drilling Barges.** W. A. Roy (9 pp.); **Drilling.** W. P. Barker (3 pp.); **Testing.** W. J. Baker (2 pp.); **Economics.** C. N. Crosthwaite (2 pp.); **Discussion.** (4 pp.)

Symposium conducted by members of BP Exploration Co. Ltd. on problems, techniques and future of submarine exploration for oil.

Fuel Cells

Fuel Cell. W. T. Grubb, Jr. (assigned to General Electric Co.) U. S. 2,913,511 (1959) Nov. 17.

Improved gaseous fuel cell is claimed in which the electrolyte is a hydrated ion exchange resin membrane, held in direct contact between a pair of gas permeable electrodes. The membrane, by chemical treatment, can be made permeable to either anions or cations.

Fuel Cells. E. Justi, H. J. Thuy and A. Winsel (assigned to Ruhrchemie AG and Steinkohlen-Elektrizitat AG.) U. S. 2,912,478 (1959) Nov. 10.

Improved fuel cell electrode is claimed which is prepared by rapidly heating a tubular or shaped carbon body to above 650°C, then rapidly chilling below 50° C by water quench and repeating to increase the pore diameter to within 10-100 Angstrom units and the inner surface area to 10-50 sq m/g. This electrode preferably is used as the oxygen electrode in an alkaline electrolyte.

3. NATURAL GAS AND PETROLEUM PRODUCTION

Drilling

'Desert Star No. 2' Joins Libyan Drilling Fleet. *Petrol. Eng.* (Drilling and Producing) *31,* B-22 (1959) Dec. (2 pp.)

World's largest trailer-mounted drilling rig has begun work in one of the world's most formidable drilling areas. Known as the Desert Star No. 2, the rig has been shipped by Camdrill International Inc. to Libya where it will take part in the rapidly expanding exploration of the North African country. The country is flat, covered with sand, and roads are non-existent, but the Desert Star No. 2 has been designed and constructed to be the most efficient rig operating under the prevailing adverse conditions.

Development and Field Tests of Hydraulic-Powered Drilling Sub for Light Rigs. W. S. Jacobsen. *Petrol. Eng.* (Drilling and Producing) *31,* B-30 (1959) Dec. (2 pp.)

After field surveys with contractors and users, it was decided that a hydraulic-powered sub to be used with a rotary swivel would be the best type to offer to the well servicing industry. One factor considered was that many contractors already operated and owned conventional rotary swivels and it would be more economical for them to use a hydraulic-powered device along with their present equipment rather than to purchase additional equipment.

Equipment Requirements for Air and Gas Drilling. F. W. Smith. *Drilling 21,* 66 (1959) Dec. (5 pp.)

Air and gas drilling constitutes very few changes in modern rotary rigs. Almost all innovations have been made in accessory equipment. Substructures usually are higher to accommodate the elaborate blowout equipment and wellhead assembly. The size of locations have been increased to accommodate air compressors or gas treating equipment without crowding the rig and its accessories. Manufacturers of equipment and accessories used in air and gas drilling are studying the needs of better equipment and developing new tools to meet the demands of contractors, operators and service companies.

Modern Well Completion Series. Part 1. Technical Advances in Oil Well Drilling. O. Hammer. *Petrol. Eng.* (Drilling and Producing) *31,* B-60 (1959) Dec. (4 pp.)

Beginning of a series on modern well completion. First article serves as a prelude and shows developments in drilling techniques from their origin to most advanced research.

Using the Hammer Drill. W. E. Liljestrand. *Drilling 21,* 66 (1959) Nov. (6 pp.)

Laboratory and field testing in 12 wells has resulted in the development of the hammer drill tool using air- or gas-operated percussion hammer to obtain drilling rate increases of two or three times that of air rotary drilling. Bit footage has been increased to as much as eight times air rotary and sixteen times mud rotary. The hammer drill is simple in construction and operating principle. It also is rugged and reliable. It can be added to air rotary drilling with no major changes in equipment or operating procedures. Where air rotary drilling is economical, hammer drilling will further reduce well costs.

Exploration

Northern California Pushes Search for Gas. W. T. Smith. *Oil Gas J. 57,* 120 (1959) Nov. 30 (2 pp.)

Spurred on by a combination of no markets for new crude production, plus a steady demand for natural gas, California operators are continuing to turn their attention to the state's northern gas counties. Article gives a rundown on drilling in eight gas counties.

What Are the Chances for Oil in the Sedimentary Basins of Brazil? W. K. Link. *Oil Gas J. 57,* 289 (1959) Nov. 16 (5 pp.)

Brazil has an area of 3,244,246 sq. miles. Of this area approximately 27% consists of sedimentary basins. There are three Paleozoic basins, four major Cretaceous basins and some smaller ones. The only commercially productive basin today is the Reconcavo in Northeast Brazil, a Cretaceous one.

Offshore Operations

ODECO Unwraps Its New Drilling Island that Floats. H. Wilson. *Oil Gas J. 57,* 44 (1959) Dec. 14 (3 pp.)

New concept in deepwater drilling has been developed on the drawing boards of Ocean Drilling & Exploration Co. (ODECO) at New Orleans, La. Most rigs so far developed for drilling in a floating condition have been converted from conventional ships and have done their drilling through a bay or opening in the hull, or over the side. Moderately bad weather can thus stop drilling activities. Rig's inventors believed that the industry needs a drilling rig which 1) floats in a partly submerged condition, 2) has a high degree of wave transparency, 3) is nautically stable, 4) has a high degree of vertical stability under varying loads, and 5) is subject to a minimum change in horizontal movement under such varying loads. The ODECO drilling island is designed to meet these stringent requirements.

Offshore Louisiana: One of the Largest Undrilled Reserves in the World. L. L. Limes and J. C. Stipe. *Oil Gas J. 57,* 126 (1959) Nov. 23 (5 pp.)

About 8375 producing wells have been completed in sediments of Miocene age in South Louisiana. The cumulative production to January 1, 1959, was somewhat more than 3 billion bbl of oil and 8 trillion CF of gas from approximately 380 fields. Current annual production from South Louisiana is about 272 million bbl of oil and 1.8 trillion CF of gas. Miocene production amounts to approximately 75% of the South Louisiana total. The offshore province of South Louisiana represents one of the largest concentrations of undrilled reserves in the world. The relatively low cost of marine geophysical surveys and their accuracy in locating salt-generated structures have led to the discovery of a number of large features that have not been drilled yet. The size and stratigraphic position of these structures make it certain that a number of major oil and gas fields remain to be drilled.

Recycling

Pressure Maintenance of West Tepetate. C. W. Ziemer and W. L. Horner. *Oil Gas J. 57,* 66 (1959) Nov. 23 (5 pp.)

Located in Jefferson Davis and Acadia parishes in Louisiana, West Tepetate field found production in two reservoirs of Miocene age. Because of the reservoir-pressure decline, an experimental pressure maintenance program was instituted in June and July 1946. After ten years' operation, authors conclude: Early reservoir performance studies indicated pressure maintenance was desirable, and the feasibility of pressure maintenance was demonstrated by the experimental water injection project. Early unitization gave maximum recovery advantage and assured equitable participation in the production from the field. Excellent cooperation of royalty owners, operators, and the Conservation Commission of Louisiana resulted in a full-scale water and gas injection pressure maintenance project before significant loss of recoverable fluids occurred. The increased recovery of oil in the Miller No. 1 and Miller No. 3 zone unit is estimated at 5,000,000 bbl for the former and 2,000,000 bbl for the latter.

Reservoir Engineering

Measurement of Gas-Phase Saturation in a Porous Medium. R. W. Snell. *J. Inst. Petrol. 45,* 259 (1959) Aug. (3 pp.)

Measurement of the gas phase saturation in the laboratory study of flow behavior of three immiscible fluids in a porous medium is of paramount importance, especially to the oil producing industry. A neutron method is described and the results obtained

show that the method is capable of indicating gas saturation to within ±2% of the void volume.

Well Practice

Modern Well Completion Series. Part 2. Improvements in Well Completion Practices. L. B. Meaders. *Petrol. Eng.* (Drilling and Producing) *31,* B-72 (1959) Dec. (2 pp.)

Oil well cementing, drillstem testing, chemical services and hydraulic fracturing are analyzed to show their contribution in successful completions.

Sonic Energy Produces Controlled Fracture. *Petrol. Eng.* (Drilling and Producing) *31,* B-50 (1959) Dec. (2 pp.)

New fracturing method which employs jet-produced shock waves was exhibited in Dallas recently. After extensive field testing in the Clinton Sand in Ohio, which is among the toughest of fracturing areas, the tool is being made available in all areas. It is an expandable wire line tool which exposes the formation and creates a horizontal fracture in a single operation. The process, called Stereo-Frac, was developed by Bruce Gilbert, inventor of the FI process.

Water-Shutoff Treatments for Air and Gas Drilling —How Successful Are They? C. K. Sufall and E. McGhee. *Oil Gas J. 57,* 123 (1959) Dec. 7 (6 pp.)

Solution to one of the big problems in air and gas drilling may be imminent. Squeezing with silicon tetrafluoride gas promises to make water shutoff routine in most cases and to reduce it significantly in the rest. The weak gel resulting from the silicon tetrafluoride gas is one of the advantages of the material. There is no danger of sticking squeeze tools in the hole when treating by this method. Treating a water zone with silicon tetrafluoride is relatively simple. Surface equipment is commonplace; and bottom-hole tools are conventional. The jobs are unusual, however, in that it may be necessary to handle as many as three gases in addition to water and oil. In spite of the simplicity of the equipment, there are precautions to take in order to insure success. First among these is that it is important that all of the water-bearing formation be drilled and thus exposed to the treatment.

Secondary Recovery

Producing Viscous Crudes from Underground Formations. J. C. Allen (assigned to Texaco, Inc.) U.S. 2,909,224 (1959) Oct. 20.

Viscous heavy crude oil is produced from a well by injecting gaseous ethane, holding to permit the ethane to dissolve in oil and producing the well at pressures below the bubble point of the ethane-oil solution.

Treatment of Underground Formations. F. A. Boyle (assigned to Sun Oil Co.) U. S. 2,908,641 (1959) Oct. 13.

Straight chain primary aliphatic amines of 1-5 carbon atoms are dissolved in a hydrocarbon solvent (0.05-2.0% by weight) and are injected via the borehole into an oil or gas bearing formation. The amine renders the sand surfaces oleophilic and increases the permeability to facilitate the flow of hydrocarbons.

4. GAS CONDITIONING AND LPG RECOVERY

Carbon Monoxide Removal

Removal of Carbon Monoxide from Fuel Gases. G. S. Cribb and J. D. F. Marsh. G. C. Communication No. 66. *Gas World 150,* 633 (1959) Nov. 21 (2 pp.)

Carbon monoxide can be removed from town gas by catalytic reaction with hydrogen to give hydrocarbons, by absorption in cuprous salt solutions or by reaction with steam on a catalyst to give carbon dioxide and hydrogen. The last method, known as the water gas shift reaction, is the most promising and has been used to treat the gas produced at Hameln and Nordhausen before World War II, and at Basle since 1958. The gas treated at these places was mainly coal gas, whereas in Great Britain more interest is attached to the treatment of carburetted water gas. Under these circumstances, the main problem associated with the water gas shift process is the fouling of the catalyst.

Gasoline

How to Select a Gasoline-Recovery Plant. R. F. McNamara. *Oil Gas J. 57,* 186 (1959) Nov. 16 (4 pp.)

Adsorption-type gasoline plants are proving to be economical at gas throughputs much higher than operators originally thought they would. When both dehydration of a gas system and gasoline removal need to be carried out: Adsorption process applied on a lean gas stream looks attractive up to 450-500 MMCF/day of gas throughput, and for a rich gas stream, upper limit of gas throughput for the adsorption process is 80-200 MMCF/day. When dehydration is not necessary: Adsorption on lean gas is attractive up to 50-110 MMCF/day of gas throughput and the upper limit for adsorption on rich gas streams seems to be about 50 MMCF/day of gas flow. Operating conditions and other factors taken into account to arrive at these figures are outlined.

Oil from Sui Gas. *Progress 4,* 5 (1959) Oct.

Brief description of Pakistan Petroleum's condensate plant at Sui, designed to distill and refine the small

quantity of liquid hydrocarbons produced with natural gas. Tests currently are underway to determine the efficiency of the plant and also the suitability of the refined products for use at the Sui Gas field.

Gasoline Recovery

How to Increase Liquid Recovery from Your Gas-Condensate Wells. A. W. Francis and J. D. Lowd. *Oil Gas J. 57,* 68 (1959) Dec. 14 (8 pp.)

Increasing importance of gas and gas-condensate recoveries demands that high efficiency recovery methods, screened for economic justification, be used on wet gas streams. Article establishes the magnitude of the efficiencies obtainable with today's methods and gives practical economic consideration to each of these methods.

Hydrogen Sulfide Removal

Proper Instrumentation Keeps Outlet Gas Sweet at Pincher Creek. C. Buskel. *Oil Gas J. 57,* 67 (1959) Nov. 30 (4 pp.)

Amine-treating section of the Pincher Creek, Alberta, (Canada) plant is capable of treating in excess of 270,000 MCF/day of sour gas at three different pressures. The individual contactors are so instrumented that either low amine flow or excessive gas flow will shut off gas to that contactor. The contactors also are equipped with flooding or foaming alarms. Amine reclaimers and solution filters assure clean amine solution for the contactors. Corrosion in the amine system has been found to be nominal. Sulfur-recovery facilities consist of three 255-long-ton units, with a fourth similar plant planned for the near future. One of the special features of this installation is an incinerator on each sulfur unit to reduce air pollution from the plant stack.

Simple Removal of H_2S from Refinery Tail Gas. *Oil Gas J. 57,* 158 (1959) Nov. 16 (2 pp.)

Sulfur-recovery plant servicing the California Co.'s Perth Amboy, N. J., refinery is using a simplified process scheme in removing sulfur from refinery tail gas. The preliminary oxidation step has been combined with a waste-heat-recovery boiler into one compact unit. The new operation is basically a modified Claus process which calls for the partial combustion of gases containing H_2S. One-third of the sulfur contained as H_2S in the gas stream is burned to sulfur dioxide. The entire stream then is catalytically reacted to complete the oxidation and recover elemental sulfur. The process flow continues from the catalyst converter through an economizer and then into a sulfur scrubber.

Vacuum Carbonate and Contact Acid Plants at Beckton. L. S. Cooper and R. M. Johnson. I.G.E. Communication No. 556. *Gas World 150,* 628 (1959) Nov. 21 (4 pp.)

Although there are several plants in the U.S.A. and in Europe for the removal of hydrogen sulfide by the Koppers Vacuum Carbonate Process, some of which are followed by contact acid plants, the installation at the Beckton works of the North Thames Gas Board is unique in Britain. Paper reviews reasons for the adoption of this process and reasons for the siting of the plant at the Beckton works are discussed.

5. NATURAL GAS TRANSMISSION

Compression

Nomograph of Gas Compression Costs and Power Requirements. S. Katell and P. Wellman. *Cost Eng. 4,* 23 (1959) Oct. (3 pp.)

Since gas compression costs can be an important economic factor in evaluating many research projects, a cost analysis of this component was undertaken, and the results compiled in nomograph form. Since the horsepower requirements must first be established, this information is included. The following limits have been established as a basis for this study: Inlet temperature, 60° F; compressor capacity, 20,000-60,000 SCF/min., and discharge pressure, 30 atm.

Compressor Stations

El Paso's New Station Has Latest in Controls. M. A. Judah. *Pipe Line Ind. 11,* 40 (1959) Nov. (7 pp.)

One of the most significant developments in the past year is that of El Paso Natural Gas Co.'s design of new electric motor-centrifugal compressor units at its Seligman and Leupp stations. At Seligman, two 5000 hp synchronous electric motors drive centrifugal compressors through single step, gear speed increasers. The electric motors are rated at 4160 v, 1200 rpm, on 3-phase 60-cycle power, with a power factor of 1.0. Motors are designed to operate at 115% of load continuously.

Engines

Pipeliners Like the Engine Analyzer. B. J. Matthews. *Oil Gas J. 57,* 110 (1959) Dec. 7 (3 pp.)

In 1958, El Paso Natural Gas Co. purchased an electronic engine analyzer for maintenance trouble shooting. After almost two years of experience with this instrument, company feels that the venture was successful. Its immediate value is as a tuneup instrument but as experience is acquired, it becomes beneficial in detecting and locating mechanical malfunctions.

Fluid Flow

The Pitot Tube . . . Another Measurement Tool. H. T. Libby. *Gas 35,* 109 (1959) Dec. (8 pp.)

Pitot tubes are commonly used for measuring liquids over a wide range of velocities, and for measuring gases at high velocities. They are not commonly used for measuring gases at low velocities. These tubes have a very definite place as instruments. They can be installed in any line or duct, regardless of size, pressure or location, without disturbing operation of the line, and without introducing additional pressure losses. They are invaluable for determining the direction and magnitude of volumes flowing in low and high pressure networks. Velocities as low as 2 or 3 ft/sec can be measured. Accuracies of the order of ±2% are within reach of the careful operator.

Suggested Procedure for Adequate Testing of Multiphase-Flow Pipelines. O. Flanigan et al. *Oil Gas J. 57,* 60 (1959) Nov. 30 (7 pp.)

Theoretical status of two-phase flow is still in a state of flux, but a survey of the various calculation methods in use shows that there are a number of essential measurements and properties which are necessary for adequate evaluation of the test data. The measurements and the properties which are believed to be necessary are presented in the article. While this procedure is directed specifically at two-phase, two-component flow, it may be modified for the case of two or more liquid phases.

Pipeline Operations

Some Suggestions for Standard Specifications for Pipeline Construction. H. M. McCamish. *Gas 35,* 117 (1959) Dec. (6 pp.)

Author believes that the industry needs a "Standard Basic Specification for Gas Pipeline Construction" which any company can use with the assurance that all essential construction requirements are fully covered. This specification would be used in conjunction with a document which spells out the special construction details to cover the unique requirements for the given job. Author presents a sample of a suitable specification, designated Specification #1000, along with a sample of a "Construction Data" to illustrate clearly the function of the latter document and how to indicate it relates to the "Standard Specification".

Welding

Welded Repairs to API 5LX-52 Pipe. T. A. Ferguson. *Oil Gas J. 57,* 73 (1959) Nov. 23 (4 pp.)

Welded repairs on 5LX-52 cold-expanded pipe can be made satisfactorily to a much greater degree than is presently allowed if the proper repair procedure is used. This is author's position, based on the tests reported in article along with previous research. Article presents a progress report on recent tests of welded repairs.

Coatings

Asphalt Coating of Pipe. J. D. Cummings (assigned to Crutcher-Rolfs-Cummings, Inc.) U. S. 2,909,825 (1959) Oct. 27.

Apparatus is claimed for compacting a coating on a large-diameter pipe which comprises an open top mold carried on a conveyor belt. The "trough" mold is filled with coating aggregate with pipe length in place, and a complementary cover mold is arranged to lower into the trough mold and compress the loose asphalt into a tight monolithic coating by vibration and mechanical pressure.

Fluid Flow

Fluid Flow Apparatus. D. R. White (assigned to General Electric Co.) U. S. 2,910,830 (1959) Nov. 3.

Apparatus is claimed for smoothing pulsations in fluid flow in conduits which comprises a hollow toroidal chamber placed coaxially on the conduit, with unobstructed passage through the conduit past the toroid, but with circumferential junction of the toroid and conduit to form an entrance to the toroid where an upstream pulsation causes a vortical flow of fluid in the torus with the reentrance of flow into the downstream conduit causing dampening of pulsations.

Pipeline Construction

Pipe Laying Apparatus and Method. P. H. Timothy (assigned one-half to Southern Natural Gas Co. and one-half to Brown & Root, Inc.) U. S. 2,910,835 (1959) Nov. 3.

Improved pipelaying machine is claimed, for use on land or water vehicles, which comprises a trackway for supporting the pipe continuously in a fixed curved path from the point where the assembly is welded to the final trench floor to the rear portion of the vehicle. The support is provided by movable carriages with their position on the trackway controlled by cables. For offshore pipelaying, the supports may be rollers controllably suspended from floats which are held at fixed positions to the rear of the assembly.

Pipeline Operations

Apparatus for Cleaning and Repairing Pipe Lines. R. J. Brant. U. S. 2,908,248 (1959) Oct. 13.

Apparatus for cleaning and repairing a pipeline internally is claimed which comprises two pairs of discs with flexible circumferential facings designed to fit tightly to the pipe wall and anchored together

by axial rods to form a chamber between pairs. The device, drawn by cable through the pipeline, clears out obstructions and the chamber carries coating material fed under pressure from surface reservoir to plug and coat internal crevices.

Pipeline Scrapers. B. ver Nooy (assigned to T. D. Williamson, Inc.) U. S. 2,909,796 (1959) Oct. 27. Pipeline scraper is claimed comprising a body carrying resiliently mounted scrapers or brushes, and with cam-like rollers also resiliently mounted to touch the pipe wall ahead of the brushes to jar loose the scale and rust and also to produce sufficient noise to locate the scraper in the pipe.

6. GAS AND LPG STORAGE

Liquefaction

Low Temperature Technology—What's the Latest? *Chem. Eng. 66,* 77 (1959) Nov. 30 (6 pp.)

At the Cryogenics Engineering Conference, international in scope, papers were presented on refrigeration, insulation, and handling and storage of cryogenic liquids. Most interesting of the new refrigeration methods is the low temperature gas expansion cycle developed by Arthur D. Little, Inc. This is a new modification of the old adiabatic expansion refrigeration process, the Stirling cycle. Article presents some of the latest information garnered from the papers presented at this conference.

Methane Liquefaction

Cavern Storage for Liquid Methane? *Petrol. Week 9,* 46 (1959) Dec. 4.

If the use of methane as a fuel in energy deficient countries catches on, space-pressed suppliers might start storing it underground, in liquid form at atmospheric pressure. Two members of the Texas Petroleum Research Committee recommend mined caverns as the cheapest and safest type of underground storage for liquid methane. Constock International Methane, Ltd., has expressed interest in the recommendation. Mined caverns are being considered in Great Britain, if the right formations can be found. In addition, salt domes probably will be used in Europe's Rhine-Ruhr district. Cost of mining caverns would be between $.75-$1.25/MCF. Tank storage could run between $6.50-$12.50 according to another source. Loss through evaporation in a cavern would be 700,000 CF/hr at the end of the first month and 100,000 CF/hr at the end of 10 years, in a spherical cavern of 100-ft radius. Underground caverns also are said to provide much safer storage than tanks for the highly volatile liquid.

Underground Storage

Cincinnati Goes Underground with LPG. W. J. Schreiner. *Gas 35,* 53 (1959) Dec. (8 pp.)

Cincinnati Gas & Electric Co. solved its seasonal peak-shaving problem by adding a propane-air gas plant and a pipeline-supplied underground storage cavern to its system. Gas plant can produce 50 MMCF/day of propane-air gas at 200 psig. It went in service in November. The 7.5-million gal underground storage cavern is the first use of this method of storing liquid propane by a gas distribution utility. Propane feedstock comes from the Little Big Inch pipeline of the Texas Eastern Transmission Corp. Economy in cavern construction and testing followed modern developments in this field. The main shaft diameter is 42 in. This shaft introduces the propane used to fill the cavern. Two 12-in. shafts and a 20-in. shaft provide for installation of a float gauge to indicate liquid level in the cavern and for installation of two deep well pumping units that supply propane from storage to Dicks Creek process plant.

"Gun Barrel" Pipe Line Solves Storage Field Problem. E. Sterrett. *Pipe Line News 31,* 30 (1959) Nov. (5 pp.)

To store gas at Leidy field (Penn.) at the desired rate, it was determined that a working pressure—input—of 5000 psi would be required at the wellhead to insure the 204 MMCF/day of withdrawal estimated to be required. Total possible withdrawal over the five winter months might be 15 billion CF. To meet these requirements, a herringbone storage and delivery pipe network was designed to cover the field, some 13.5 miles long and more than half that wide. Backbone of this system was to be a 12-in. line, extending the length of the field, with laterals of 10-, 8- and 6-in. pipe. Special reciprocating compressors were installed in the Leidy station, three of 2000 hp and two of 1000 hp each. Gas would be supplied the station by New York Natural, Transcontinental Gas Pipeline and other users of the field.

Pressure Storage of Town Gas in an Underground Cavity. E. Crowther. I.G.E. Communication No. 558. *Gas World 150,* 614 (1959) Nov. 21 (3 pp.); **Pressure Storage in a Prepared Underground Cavity.** *Gas J. 300,* 375 (1959) Nov. 25 (5 pp.)

Preparation of a cavity in a natural seam of rock salt situated nearly ¼ mile below the surface of the ground is described, and its subsequent employment as a pressure vessel for the storage of town gas is discussed. Its storage capacity at the normal maximum working pressure of 30 atm is equivalent to that of a 10 MMCF low-pressure holder. Capital and operating costs are tabulated, and certain of the effects of compression and residence in storage are presented. The paper is prefaced by some general

considerations concerning the functions of storage capacity in the over-all economics of gas supply.

Methane Liquefaction

Low Temperature Refrigeration. P. E. Bocquet and S. E. Tung (assigned to Constock Liquid Methane Corp.) U. S. 2,909,906 (1959) Oct. 27.

Improvement in methane refrigeration, as applied to liquefaction, is claimed for a method in which liquid nitrogen, pressurized to above its critical pressure, is heat exchanged with methane until N_2 is above critical temperature. Then the nitrogen is expanded in a working turbine to obtain further temperature reduction. Gaseous nitrogen is used in the second stage of heat exchange with methane now compressed by the turbine.

Liquefied Gas Refrigeration System. C. A. Richardson (assigned to R. C. Pratt.) U. S. 2,909,039 (1959) Oct. 20.

Refrigerating system utilizing liquefied air, nitrogen or oxygen, is claimed in which a liquid gas container is arranged to feed by gravity to a flash chamber exposed to the refrigeration chamber. The evaporated gas in the refrigeration chamber is used to force a circulation of gas-liquid coolant in the heat exchange coils.

Storage Tank for Cold Liquids. C. D. Dosker (assigned to Constock International Methane Ltd.) U. S. 2,911,125 (1959) Nov. 3.

Tank for storing cold liquids, such as liquefied methane, is claimed, consisting of a bottom member built up of insulating wood bonded with hardwood facings, with a shouldered edge for supporting vertical insulated wall panels which are self-supporting and sealed together at vertical edges and are held together by encircling retaining bands. This insulated structure is lined with a thin, gas-tight metal sheet over the bottom and wall, supported with an internal structure of wooden rings, held by laminated wood columns, with an inward extending flange on the inner tank lining held in a circumferential groove in the outer face of each wooden ring.

7. MANUFACTURED GAS AND CHEMICAL PROCESSING

Carbonization

The Chemistry of Carbonization, Studied by Polymer Coal Model Material. V. Pyrolysis of Models with Functional Groups. P. M. J. Wolfs, D. W. van Krevelen and H. I. Waterman. *Brennstoff-Chemie 40,* 314 (1959) Oct. 21 (13 pp. German text.)

Mechanism of pyrolysis of model compounds with functional groups, especially oxygen groups, was studied. It appears that in many cases these mechanisms are similar to those of nonfunctional materials. Thus it was shown that the depolymerization during disproportionation of the nonaromatic hydrocarbons is of real significance and the carbonization occurs in two quite different phases: The primary coking with tar formation, and secondary coking leading only to gas formation. In contrast to the nonfunctional model materials the selectivity of gas and tar formation is now less sharp, understandable because the side structures and groups are decomposed simultaneously with the bridging systems. Because of the presence of functional groups a side reaction competes with depolymerization, with condensation and splitting of simple compounds (water). These side reactions are especially noted wtih phenolic models and can preponderate so that no depolymerization and tar formation occur. Reaction and analytical data for several phenolic resins and ether condensates are diagrammed and discussed.

Catalysts

Evaluation of Catalysts for Hydrogenating Shale Oil. H. C. Carpenter and P. L. Cottingham. *U. S. Bur. Mines Rep. Invest. 5533* (Washington: U. S. Govt. Print. Off., 1959.) (29 pp.)

Data are presented comparing results obtained with 17 different catalysts in hydrogenating crude shale oil to gasoline in single-pass operation. A method is described for predicting the maximum yield of gasoline obtainable at constant pressure for each catalyst from results of a limited number of experiments at different temperatures. Operating variables have considerable influence on yields and properties of products. With most of the catalysts, at operating temperatures below 890° F liquid yield exceeded 100 volume-percent. Above this temperature the volume of liquid product decreased rapidly. Maximum gasoline production in most instances was achieved at a temperature higher than that at which the maximum volume of liquid product was produced. Yields and properties of gasolines differ considerably with different catalysts.

Coal Gasification

Gasification of Pulverized Fuel in a Fluidized Bed at 15 Atmospheres Pressure. G. P. Sechenov and V. S. Altshuler. *Gazovaya Prom. 11,* 14 (1959) (5 pp. Russian text.)

On the basis of laboratory tests in which electrode carbon and peat semicoke were gasified in a fluidized bed at pressures of up to 15 atm and at temperatures of 770-870° C (semicoke) and 1160-1260° C (carbon), using a steam-air blast and a

steam-oxygen blast, the authors conclude that increased operating pressure reduces carry-over of fines, increases heating value of gas, and increases gasification rates. The gasification rate increases as the square root of absolute pressures. A typical analysis for gasification of semicoke with steam-oxygen blast at 15 atm pressure was 34% CO_2, 17% CO, 43% H_2 and 4% CH_4.

J. W. Penney

Ethylene

Pyrolysis of Mixtures of Gaseous Hydrocarbons Containing Ethylene. L. I. Kulichenko, S. D. Razumovskii and L. C. Semenova. *Gazovaya Prom. 11,* 40 (1959) (4 pp. Russian text.)

Butane, butane-pentane mixtures, and oil gas, with added ethylene were cracked in a quartz reactor to determine the effect of ethylene in the original mixture on the total yield of ethylene. The reduction in total ethylene was approximately equal to the ethylene content in the original mixture.

J. W. Penney

Ore Reduction

Direct Reduction: The Flash Steel Process. J. J. Burke. *J. Metals 11,* 747 (1959) Nov.

General outline of flash steel process patent whereby pellets of sintered ore float down through a stream of rising gas, producing molten 1% C steel. Pellets from ⅜-⅝ in. in diam and of specified strength and porosity are preheated to 1400° F in a rotary kiln and fed into the top of the reactor. A reducing gas of approximately 70% CO and 30% H_2, made by burning soft coal in oxygen, is fed into the bottom of the reactor.

Petrochemicals

Metallorganic Compounds in Petrochemistry. K. Ziegler. *Rivista dei Combustibili 13,* 621 (1959) Sept. (18 pp. Italian text.)

After stressing importance attached to metallorganic compounds in petrochemistry, new methods of preparation and their main applications are described. As polymerization catalysts they have made it possible to obtain polyethylene by polymerizing ethylene at atmospheric pressure; and likewise from the higher homologues, propylene, α-butylene, styrene, important plastics have been produced. Another use to which Ziegler catalysts are put is the synthesis of high molecular weight, straight chain, fatty alcohols starting with ethylene. New method for producing tetraethyl lead is described. New process involves only four stages instead of six. Reactions take place at 100° instead of 600° C. Less power is consumed, while efficiency is close to 100%.

Propane

The Mercury-Photosensitized Decompositions of Propane and Ethane. R. A. Back. *Can. J. Chem. 37,* 1834 (1959) Nov. (9 pp.)

Mercury-photosensitized decompositions of propane and ethane have been studied at pressures of 300 and 600 mm at 24° C at very low conversions. Hydrogen was the only product identified and measured. The hydrogen yield fell rapidly at first, with increasing time of irradiation, and finally became constant. This behavior is attributed to the accumulation in the system of propylene or ethylene formed by the disproportionation of propyl or ethyl radicals and the constant rate of hydrogen production finally achieved is thought to correspond to a steady state concentration of the unsaturate. Previous values of the quantum yields of these decompositions were probably measured in this steady state region and must be corrected upwards.

Synthesis Gas

Hydrogen's Revolutionary Role. *Chem. Eng. 66,* 178 (1959) Nov. 16 (5 pp.)

Description of the Texaco partial oxidation process for the generation of synthesis gas—hydrogen and carbon monoxide. Many factors led to the undertaking of the development of a process for generating hydrogen and carbon monoxide at higher than synthesis pressures. Among them was the fact that natural gas was often available at very high pressures and since most hydrocarbon syntheses required synthesis gas at 300-500 psig, it was obviously desirable to avoid recompression if at all possible. Conventional catalytic steam-methane reaction did not seem acceptable. Discussion of Texaco's approach and solution to the problem.

Tar

Effluent Disposal and Electro-Detarring. W. H. Blackburn, M. Kershaw and J. R. Catchpole. G.C. Communication No. 60. *Gas World 150,* 626 (1959) Nov. 21.

For many years, it has been known that the practice of hot gas detarring reduces the amount of higher tar acids in gasworks liquor and that very beneficial results have been obtained at Hinckley, where, in addition to hot gas detarring, the retort house liquor is excluded from the bulk of the liquor. The investigation reported was undertaken because there was some uncertainty as to how much of the benefit obtained at Hinckley was due solely to hot gas detarring and how much to the accompanying exclusion of the retort house liquor.

Thermal Refining of Low-Temperature Tar. J. B. Goodman and R. S. Detrick. *U.S. Bur. Mines Rep.*

Invest. 5534, (Washington: U.S. Dept. of the Interior, 1959.) (43 pp.)

Summary of work conducted by the Koppers Co., Inc., in cooperation with the Bureau of Mines on the commercial evaluation of the primary low-temperature tars produced from Texas lignite in the Rockdale, Texas, plant of the Aluminum Co. of America in conjunction with the Texas Power and Light Company. Interest of the Bureau is twofold. First, it has assisted in the technical design and practical operation of the prototype, externally heated, entrained-state carbonizer for producing char for electric-power production and for primary low-temperature tar. Second, the first successful operation of the prototype carbonizers employing the Bureau of Mines-Parry process on lignitic coal in 1953-4 led to the production of large quantities of primary lignitic tar, concerning which too little was known or had heretofore been published in this country. The Oil-from-Shale Demonstration Plant refinery unit of the Bureau at Anvil Points, Colo., appeared to offer a practical size facility for refining low-temperature tar on an experimental scale.

Wastes

Waste-Water Aeration May be Key to More Efficient Removal of Impurities. B. V. Prather. *Oil Gas J. 57,* 78 (1959) Nov. 30 (8 pp.)

Limited study of the effects of aeration on the chemical characteristics of total waste-water effluent from its Tulsa refinery has been conducted by DX Sunray laboratories. The results of preliminary experiments were so promising that a more comprehensive program was initiated, designed to establish the most effective and economical method of aeration. This program included studies of three types of aeration and their combinations; i.e., aeration by air diffusion through water, spraying water through air, and pumping water over cascades. Article covers aeration by diffusion of air through water, and a combination of the three processes.

Acetylene

Process for Conducting Gaseous Reactions. B. H. Sage (assigned to Texaco Development Corp.) U.S. 2,908,733 (1959) Oct. 13.

Hydrocarbon such as methane is thermally converted to products such as acetylene by passing with air into a primary reaction zone at above 1000 ft/sec and then through a nozzle either with or without shock wave to attain temperatures at or above 3000° F, after which the stream is decelerated and cooled and the product is recovered.

Purification of Gases. R. A. Koble (assigned to Phillips Petroleum Co.) U.S. 2,907,409 (1959) Oct. 6.

Entrained solvent for acetylene is removed from an ethylene stream by injecting liquid ethylene at the absorber top and also injecting pure ethylene at the mid-column raw feed in order to saturate the solvent.

Hydrogen

Hydrogen Purifier. R. B. Green and J. S. Hill (assigned to Engelhard Industries. Inc.) U. S. 2,911,057 (1959) Nov. 3.

Hydrogen purifier is claimed which consists of a shell with a plurality of palladium metal tubes of equal length, helically coiled within right- and left-hand layers, with tube ends secured in end plates sealed to the casing. Impure hydrogen is passed into the tubes, purified hydrogen diffuses into the shell from which it is drawn, while impurities are flushed occasionally from within the tubes. The whole unit is heated with a resistance winding.

Method of Making Hydrogen. P. S. Viles (assigned to Esso Research and Engineering Co.) U. S. 2,911,-288 (1959) Nov. 3.

Process is claimed for preparing hydrogen which comprises forming a bed of supported catalyst of cobaltous oxide and molybdic trioxide mixed in mol ratio of 0.1:1-1:0.1 in a reaction zone, contacting saturated hydrocarbons of 1-3 carbon atoms at 850°-1600° F and 1000 psig, recovering hydrogen and, in a final step, recirculating unreacted hydrocarbons.

Production of Gases Rich in Hydrogen. W. C. Offutt (assigned to Gulf Research & Development Co.) U. S. 2,910,411 (1959) Oct. 27.

Production of hydrogen is claimed for a process comprising first coking a carbonaceous material (petroleum) to form green coke, preferably by the delayed coking process. This material then is charged to a calcining retort, where it mixes with hot fluidized coke particles already calcined (and reheated to 1800° F in a separate vessel by combustion with oxygen). The gases from the calciner, high (about 70%) in hydrogen, are collected and stored.

Oil Gas

Fluidized Solids Town Gas Manufacturing Process. R. E. D. Haney (assigned to Esso Research and Engineering Co.) U. S. 2,912,315 (1959) Nov. 10.

Process is claimed for making a gas containing hydrogen and carbon monoxide by maintaining a steam fluidized bed, by adding preheated solids at 1700°-1900° F, injecting heavy tar at the base of the bed, removing gas and suspended solids vertically at high temperatures and injecting heavy oil into the stream. The solids are separated and returned to the fluidized

bed. The gases are then water-quenched, first to remove heavy tar slurry and finally to remove the light tar.

Refinery Gases

Controlling the B.T.U. Content of Residue Gas from a Hydrocarbon Separation System. T. C. Flavin (assigned to Phillips Petrol. Co.) U. S. 2,910,435 (1959) Oct. 27.

Method is claimed for controlling the heating value of a residue gas (mostly methane) from a natural gasoline plant, whereby the vapor stream richer in normal butane than propane is withdrawn from an intermediate plate of the separation column and added to the residue gas. The heating value of the mixed gas is continuously measured by a calorimeter which controls the vapor addition, thereby minimizing variations in the mixed gas calorific value to permit its use as pipeline gas. Vapor streams also may be drawn and controlled from the absorber, reabsorber, deethanizer or stabilizer zones.

Shale Oil

Extraction of Oil from Oil Shales and Like Oil Bearing Material. G. R. Coulson (assigned to Can-Amera Oil Sanas Development Ltd.) U. S. 2,911,-349 (1959) Nov. 3.

Shale oil is recovered by heating shale in superheated steam at 570°-1200° F and above 150 psig to disintegrate shale to powder, cooling the powder below 100° C, adding a dispersing agent and two volumes of water and centrifuging to recover oil.

In Situ Retorting of Oil Shale. H. Purre (assigned to Phillips Petroleum Co.) U. S. 2,911,206 (1959) Nov. 3.

Hydrocarbons are recovered from an underground stratum lying adjacent to a permeable stratum by a process comprising the construction of a tunnel parallel with and along a section of these strata, forming one or more boreholes through said strata spaced away from the tunnel, and heating the oil-bearing strata by injection or producing hot gas in the tunnel and forcing the gas through strata pores to the borehole, thereby heating the impervious shale layer and driving the oil therefrom and into the borehole.

System for Recovering Oil from Solid Oil-Bearing Materials. E. V. Murphree (assigned to Esso Research and Engineering Co.) U.S. 2,908,617 (1959) Oct. 13.

Oil is recovered from lump raw shale by passing downward through preheating, retorting and combustion beds in superimposed arrangement in which the processing heat is obtained by direct countercurrent contact of fluidized shale fines from the later (lower) stages of operation. Combustion air may be preheated by a further cooling stage handling spent shale.

Synthesis Gas

Production of Gas. P. S. Viles (assigned to Esso Research and Eng. Co.) U. S. 2,911,293 (1959) Nov. 3.

Method for producing carbon monoxide and hydrogen is claimed which comprises contacting a mixture of a catalytic amount of cobalt molybdate and amorphous carbon with a gaseous charge stream containing vaporized water as the sole reactant while maintaining a temperature within the range of 850° F-1600° F and recovering said carbon monoxide and hydrogen.

8. GAS DISTRIBUTION

Distribution Systems

Gas Grid Extensions. N. T. Fallon. *Gas World 150,* 574 (1959) Nov. 14 (5 pp.)

Article is concerned with the extensions to the West Yorkshire (England) grid, which, at Vesting Day, comprised 77 miles of high-pressure gas main, linking 18 undertakings with three coke ovens and handling 15 MMCF/day of gas. The system now has been extended to 153 miles by the integration of 11 additional undertakings and handles 32 MMCF/day of gas at a maximum pressure of 30 psi.

Leakage

Advanced Technology Applied to Leak Detection. I. Deutsch. *Gas 35,* 66 (1959) Dec. (6 pp.)

Development of large diameter high pressure pipelines and demands of World War II placed the gas industry into a new competitive position. Use of high pressure piping for transmission and distribution provided advantages enjoyed by distributing electricity at high voltages. But these advantages were offset somewhat by the greater hazards from leaks and breaks in the main. Article deals in general with the application of advanced technological developments to the gas industry. More specifically it is desired to use vapor phase chromatographic separation and broad band positive infrared analysis techniques to qualitatively detect methane and ethane, the distinguishing components of natural gas, in a leak detection vehicle.

Meters

Cost Reduction through Consolidation of Meter Maintenance. G. R. Rose and D. R. Stoneburner. *Gas 35,* 61 (1959) Dec. (3 pp.)

To handle the larger number of meters, and to

streamline the flow of maintenance work at the Ohio Fuel Gas Co. (Columbus), the company recently consolidated meter maintenance operations in a single, newly equipped shop in Columbus. Previously, the company also had operated a shop in Toledo. Among the new equipment installed are a gas-fired, 76-ton air conditioning system for cooling and heating; an automatic overhead conveyor system for transporting domestic meters through repair processes; automatic paint remover; gas-fired top removers for tin meters, and a hydraulic elevator at the loading dock. During its first months of operation, the shop handled about 2800 meter repairs/month. Next goal is 3600 meters/month, while the design of the shop may eventually allow the handling of as many as 4600 meter repairs/month and retire 1200 meters/month.

Meter Repair: Procedures and Practices. A. Rauth. *Gas Age 124,* 28 (1959) Nov. 26 (5 pp.)

Meter repair procedures and practices can readily cover a large field involving an over-all meter shop operation or one particular phase such as a prover room, repair room or paint room. Article covers over-all meter shop. Author points out that no two shops will operate in exactly the same manner in the maintenance of gas meters. There are several reasons for this: First, a lack of standardization in gas meters; second, different climates in which meters must operate, and third, the type of gas used, although this latter factor is readily being overcome in that in most cases natural gas is used.

Operating and Testing Connersville Meters. G. Dougill. I.G.E. Communication No. 557. *Gas World 150,* 631 (1959) Nov. 21 (2 pp.)

Up to the beginning of World War II, positive wet drum meters were mainly used for measuring town gas and, in the introduction to the paper, the author gives the reasons for the rapid change from these to the Connersville meter. It is shown that the characteristic qualities of the Connersville meter differ greatly in action.

Piping

Sidebranch Fitting for Main Supply Pipe. F. Rings (assigned to G. Kromschroder AG.) U. S. 2,913,259 (1959) Nov. 17.

Sidebranch fitting for a gas main supply pipe is claimed, which comprises essentially a cast fitting of a concentric-passaged cross. The vertical double connections pass gas to a double-connection pressure regulator and a double-connection gas meter. The annular horizontal connection passes gas from the street service pipe through the fitting to several customer meters, while the 90-degree outlet passes metered gas to customer's appliances.

9. GAS FUEL UTILIZATION AND APPLIANCES

Absorption Cooling

Why Refrigerant 22 Should Be Favored for Absorption Refrigeration. B. J. Eiseman, Jr. *ASHRAE J. 1,* 45 (1959) Dec. (6 pp.)

For a complete and detailed comparison of absorption systems, full, accurate information would be required on properties as well as on data on the rate of solution and disengagement of the refrigerant and the rate of heat transfer under the unit operating conditions. While such information is not completely available, it has proven feasible to make an adequate comparison of refrigerants on the basis of more limited data. Published data for a Refrigerant 21 unit, using the dimethyl ether of tetraethylene glycol as absorbent, have been used as a standard of comparison. A comparison of the six other refrigerants with Refrigerant 21 was made on a ratio basis so that the relative merits of each could be established independently of the specific machinery used. It was found that while Refrigerant 21 is best on the basis of its thermodynamic and physical properties, its chemical stability is not good. Refrigerant 22, in second place according to coefficients of performance, is excellent and is the preferred fluoroalkane refrigerant.

Air Pollution

Coast's Largest Steel Plant Keeps Air Clean. J. Smith. *Air Eng. 1,* 21 (1959) Nov. (4 pp.)

Kaiser Integrated Steel Plant at Fontana, Calif., is the largest of its type on the West Coast. The innumerable air cleaning problems in such a plant, from the blast furnaces to the rolling mills, are complicated at the Fontana plant by Southern California's well known inversion condition which traps air pollutants near ground level. Solutions to these air cleaning problems, many of which were originated at this plant by Kaiser engineers, and many of which are unique at this installation, will be of interest to air engineers who have air cleaning problems of all types.

The Control of Atmospheric Pollution by Gas Works. A. E. Haffner. *Gas World 150,* 532 (1959) Nov. 7 (7 pp.); *Gas J. 300,* 320 (1959) Nov. 18 (9 pp.)

Article is an account of what has been done by the gas industry to heat treat a dusty raw material to produce gas and a dusty solid residue and to gasify some of this dusty solid byproduct, accompanied by formation of gas derived from cracking of oil. In tackling the problems of dust and smoke control,

gas engineers have been prompted to do so primarily to improve working conditions of gas industry employees and to enable them to carry out their tasks in a tidy manner without offense to their neighbors.

An Industrial Hydrogen Sulfide Air Pollution Control and Monitoring Program. J. A. Monferdini and G. T. McBride, Jr. *Ind. Eng. Chem. 51,* 89A (1959) Dec. (2 pp.)

In the plan for hydrogen sulfide control, in the Beaumont South Park area (Texas) the existence of sources of hydrogen sulfide from the oil producing operations on the field had to be considered. Independent oil producers on the Spindletop field were using oil-salt water separators in their production methods and salt water from these separators was discharged into open field ditches which led to a salt water collection system discharging into the Neches River. Hydrogen sulfide which was present in the salt water was emitted and, during conditions of high humidity and southerly winds of low velocities, air with this hydrogen sulfide would move into the adjacent South Park area of Beaumont.

Particulate Pollutants in the Air of the United States. C. E. Zimmer, E. C. Tabor and A. C. Stern. *J. Air Pollution Control Assoc. 9,* 136 (1959) Nov. (8 pp.)

Report shows that a plot of the cumulative frequency distribution on log-probability paper is sufficiently reliable to establish the log-normality of a specific distribution of suspended particulate concentrations. A method is demonstrated for estimating the geometric mean and stand geometric deviation from a plot of the decile values on log-probability paper. Use of the geometric mean and standard geometric deviation is described and the necessity for considering both parameters in discussing levels of concentration is illustrated. A classification of the urban stations by the two descriptive parameters shows that 70% of the cities had geometric mean particulate concentrations less than 175 $\mu g/m^3$ and standard geometric deviations less than 1.70.

Flame Research

Consumption of Oxygen Molecules in Hydrocarbon Flames Chiefly by Reaction with Hydrogen Atoms. C. P. Fenimore and G. W. Jones. *J. Phys. Chem. 63,* 1834 (1959) Nov. (5 pp.)

Rate of consumption of 0_2 is measured by probe sampling through low pressure, flat, premixed flames of CH_4, O_2, A or through flames with C_2H_2 or C_3H_8 fuels, all burned on cooled porous burners with flame temperatures of 1300-1950° K. H also is measured in the same flames by the rate of formation of HD from added D_2 or D_2O, and turns out to be the concentration required, within 30%, to account for the observed $-d(O_2)/dt$ according to the known rate of the reaction, $H + O_2 = OH + O$. It is concluded that O_2 is consumed chiefly by reaction with H atoms in either lean or rich hydrocarbon flames.

Flame Propagation through Kerosine Foams. A. Bartkowiak, S. Lambiris and M. G. Zabetakis. *Combustion and Flame 3,* 347 (1959) Sept. (7 pp.)

Under certain conditions, liquid fuels such as kerosine may form foams flammable at temperatures below the flash point of the fuel. Thomas found that at one atmosphere pressure kerosine foam would not burn in air but would burn in oxygen-enriched air. Since it appeared possible to produce flammable foams with certain combustible liquids in air, an investigation was undertaken to determine the conditions under which these foams would be formed. It was found that flammable foams could be produced quite readily with kerosine and other light oils in air and in nitrogen- and carbon dioxide-enriched air. Because these foams constitute a potential gas explosion hazard, a series of experiments was conducted in various enclosures to determine the maximum pressures developed when these foams were ignited. Tests were conducted in containers ranging from about 0.1-10^3 ft^3. The maximum pressure was found to be a function of the amount of foam, free space above the liquid surface and number of points of ignition. Maximum pressures of 35 psi gauge were encountered in small containers.

The Limits of the Eigenvalue of the Laminar Flame Equation in Terms of the Reaction Rate-Temperature Centroid. J. Adler. *Combustion and Flame 3,* 389 (1959) Sept. (9 pp.)

Differential equation describing one-dimensional laminar flame propagation for temperature explicit reaction rate functions is considered. It is shown that for a fixed centroid of the reaction rate function, the burning velocity must lie within certain limits, which are independent of the type of reaction considered.

Furnaces

Gas in the Making of Electric Motors. E. Ford. *Gas J. 300,* (Gas in Ind. Sect.) 254 (1959) Nov. 4 (6 pp.)

At Newman Industries Ltd., an important application of gas is found in the press shop where the laminations for stators and rotors are subjected to a blue annealing process in a gas-fired furnace manufactured by the Incandescent Heat Co. Ltd. There is a variety of gas-fired equipment including Morgan Crucible furnaces for melting an aluminum alloy. It also is necessary to preheat the laminations before they are inserted in the die-casting machine and the

metal poured into the die. Among the equipment are several batch-type ovens, typical of which is a rectangular oven fitted with bar-type natural draft burners. Material is placed in the oven for preheating to about 300° C. Another smaller oven for preheating employs Schwank-type burners. Gas is used in the foundry itself for preheating of the ladles used in pouring the molten metal for casting. There is considerable more gas-fired equipment in such ancillary operations as the preparation of shell molds and drying of cores and molds.

Recuperative Gas Fired Furnace for Temperatures of 2000° C. E. A. K. Patrick and R. D. Hastie. G. C. Communication No. 62, *Gas World 150,* 625 (1959) Nov. 21.

Upward trend in industrial process temperatures, which commenced in prehistoric times, has in recent years become increasingly significant. Higher operating temperatures of items such as jet engines and gas turbines engender, in their turn, a need for test equipment working at even higher temperatures. Modern processes such as powder metallurgy also provide new openings for high temperature equipment.

Heat Treating

Birlec Gas Carburizing Plant for Ford Motor Works. *Ind. Gas.* (Brit.) *22,* 8 (1959) Oct. (3 pp.)

Two Birlec continuous gas carburizing furnaces are in operation at the Dagenham (England) works of the Ford Motor Co. Both are gas fired and of the double-track pusher type. The first of these furnaces has been in operation for over two years and is engaged in carburizing pinions at a net output of 600 lb/hr, based on a cycle time of 20 hours, though a timing clock is provided that may be preset to any desired time cycle to allow for a total time in the furnace of between 5 and 15 hours. After being carburized at 925° C, the work is dip-quenched direct from the furnace at 800° C.

Flexible Heat Treat Facility Solves Several Problems. J. Lotter. *Ind. Gas* (Amer.) *38,* 6 (1959) Nov. (4 pp.)

Heat treating equipment at Milwaukee Gear Co. consists of two Super Allcase atmosphere controlled furnaces, a Forc-Aire horizontal convection furnace, a circular pot type hardening furnace, a spray type washer with temperature control, a 2000 CF/hr DX gas generator, a 2400 CF/hr RX gas generator with Autocarb signalling dewpoint control, and an automatic dewpoint control system to be used in conjunction with one of the Super Allcase furnaces. Two 48 by 48-in., pit type carburizing furnaces are installed directly opposite this line of equipment. All furnaces in the new department were designed and built by Surface Combustion Corp., Toledo, Ohio.

Industrial Heating

Flame Traps for Use with Town Gas/Air Mixtures. P. A. Cubbage. G. C. Communication No. 63. *Gas World 150,* 620 (1959) Nov. 21 (3 pp.)

One method of utilizing town gas in industry is to prepare an air/gas mixture in the factory and to distribute this to the points of use. The mixtures are often inflammable as distributed; if the mixture becomes ignited, flame can spread throughout the pipe layout and the accompanying pressure surge can cause damage. This hazard is eliminated by the use of a flame trap to arrest travel of the flame. Although it is standard practice to fit such traps, there was a serious lack of information on the effectiveness of available traps. The main object of the investigation reported was to insure that an effective trap became available.

Heat Processor Covers Brazing, Soldering and Hardening. *Gas World* (Ind. and Comm. Gas Sect.) *150,* 71 (1959) Nov. 21 (2 pp.)

New Gascomatic heat processing unit now is being marketed by the Gas and Fuel Corporation of Victoria, Australia. This is a gas-fired automatic machine designed for a variety of processes, requiring precise temperature and timing. An air-gas mixture under governed pressure is fed to precision burners, the position of which on the standard work table is adjustable to accommodate different sizes and shapes of articles to be treated.

Investigations into Use of Town Gas in Industry. D. W. Gill and G. G. Thurlow. I. G. E. Communication No. 559. *Gas World 150,* 619 (1959) Nov. 21 (2 pp.)

Presentation of some aspects of the research with which the British Coal Utilization Research Association recently has been concerned. Paper reflects on possible future trends in the gas industry, as it may be found that much of the Association's work (for example, on boilers and furnaces), which is irrelevant to the relatively small and specialized gas-fired plants now mainly in use, will, in the course of time, be of greater application to an expanding gas industry. Authors do not attempt prophecy as to the future of the gas industry, but they believe it is worth to bear in mind the inherent advantages of industrial gas firing and the possible lines along which development may take place.

LPG-Fired Peat Moss Drying Operation Cuts Freight Costs 46 Per cent. J. A. Thompson. *Butane-Propane News 21,* 52 (1959) Dec. (2 pp.)

Essentially simple in design, peat moss drying unit

is similar to a crop drying installation. Peat moss is carried by a farm-type elevator to the top of a 20-ft-high steel silo, measuring approximately 24 x 30 in. Inside the silo is an inner core of perforated steel through which the peat moss drops downward. The drying unit will produce 1-4 million Btu/hr. The equipment is designed to extract 5 gal/min of water, operating at about 200° F. For economic operation, a humidistat with a modulating valve supplies the amount of heat needed, according to the water content of the particular batch of moss. Full capacity operation burns approximately 40 gal/hr. Fuel is supplied from a single 1000-gal tank.

Manufacture of Laboratory Glassware and Glass Plant for Industry. *Ind. Gas* (Brit.) *22,* 18 (1959) Oct. (6 pp.)

When the firm of Quickfit & Quartz Ltd. (England), which was formed in 1934, made a move to Stone, Staffs., in 1946, one of their problems was to insure an adequate supply of town gas, since the small gasworks at Stone could offer only 600 CF/hr and the fuel requirements of the factory were ten times as much. However, realizing that town gas is an essential fuel in the manufacture of standardized ground-glass joints for laboratory glassware, this firm arranged for a special 8-in. main to be laid from Stafford, some seven miles distant. Today gas consumption at the plant is in the region of 20 million CF/annum.

From Mine to Roof, Ruberoid Processes Gypsum into Rolls. M. Silverstrone. *Ind. Gas* (Amer.) *38,* 4 (1959) Nov. (3 pp.)

Ruberoid Co.'s plant at Wheatland, N. Y., plans increased use of natural gas to retain quality, speed output. Gas was selected as the fuel for the calcining plant in competition with coal and No. 6 oil in spite of the fact that its cost was estimated to be higher. It was chosen because the company's management believed that they could get a better quality product with gas. Furthermore, on coal operation the calcining plant had a total of 22 people working three shifts whereas now eight men on two shifts turn out the same amount of work. Maintenance costs for the gas-fired heating equipment have been negligible, and maintenance costs on the steel kettle bottoms and masonry have been much reduced.

New Ford Glass Plant, All Gas, Produces 400 Tons Daily. T. Hart. *Ind. Gas* (Amer.) *38,* 2 (1959) Nov. (2 pp.)

With the completion of the largest integrated glass producing plant in the world, at Nashville, Tenn., Ford Motor Co. greatly eased their problem of ever-increasing glass requirements. Natural gas is the principal fuel used in glass melting and in the various glass bending operations. The boiler plant consists of three 80,000-lb boilers operating at 125 psi. The base process steam load amounts to 40,000,000 lb/month. Most of the steam is fed into an accumulator tank which acts as a surge tank to equalize the intermittent demand of the glass laminating autoclaves. Pressure reducing stations are provided to supply steam at 30 psi for building heating and process hot water.

Ovens

New Principle Employed for Continuous Baking of Signs in Huge Capacity Twin-Tunnel Oven. *Ind. Heating 26,* 2313 (1959) Nov. (4 pp.)

Ideas for air movement, temperature control and conveyance incorporated in new large oven may well be applied in paint baking of metal products that must be closely packed or stacked during production. Oven features twin tunnels incorporated into a single 21-ft-wide by 10½-ft-high shell. Each tunnel has a separate conveyor and heating system. Air in each of the twin sections (each representing a volume of 5000 CF) is circulated at the rate of 65,000 CF/min. Each of the heating systems has a capacity of 45,500,000 Btu and each is regulated with a modulating air-operated temperature controller for maintaining temperatures within several degrees of the setting.

Space Heating

Gas Heating and Its Place in the Gas Industry. G. Duwel. *Gas- u.-Wasserfach 100,* 1050 (1959) Oct. 16 (9 pp. German text.)

Author discusses the possibilities of technical production and the economics of increased gas supply to utilities for use in house heating. He concludes that utilities should supply this since it is the best area to improve the market for gas. Peak demands of recent years for Hamburg are compared on monthly and daily bases with average temperature. Types of gas supply and other fuels are mentioned. House construction, heat requirements, types and cost of gas heating also are included.

Ventilation

Performance of Natural Flue Terminations. D. R. Wills, E. W. G. Dance and G. H. Blench. G. C. Communication No. 61. *Gas World 150,* 634 (1959) Nov. 21 (2 pp.)

Study of publications dealing with flue terminals has indicated a lack of reliable data on terminal performance and how it should be assessed. Although downdraft troubles with open appliances are well known, there appears to be a dearth of coordinated information that might have arisen from fundamental research on the design and performance of the associated flue terminal units. It is apparent from the

multitude of different types of terminals in existence that the approach to design has up to this time been mainly empirical and that factors other than aerodynamic performance have intervened. Nevertheless, it would seem essential, particularly for gas appliances, to be able to determine and compare performance characteristics of flue terminals.

Absorption Cooling

Absorption Refrigeration System and Method of Treating the Same. N. E. af Kleen and W. J. Poehlman (assigned to A. O. Smith Corp.) U. S. 2,909,-041 (1959) Oct. 20.

In an absorption refrigeration system an improvement is claimed comprising separately dehydrating and degasifying the refrigerant and the absorbent to reduce the moisture to below 0.004% and the gas content to less than 0.1 ml/l of mixture. The refrigerant and absorbent then are remixed under vacuum and are recharged to the cycle.

Cookers

Food Cooking Apparatus. F. O. Hess (assigned to Selas Corp. of America.) U. S. 2,908,267 (1959) Oct. 13.

Range-type cooker is claimed which comprises flush top radiant burner with combustion products and cooking fumes withdrawn by separate conduits and cycle by a motor-driven fan into the air-intake of the burner. Part of the fumes are used to cool the stack gases by passing through a jacket pipe.

10. EQUIPMENT AND INSTRUMENTATION

Automation

Let's Keep Automatic Controls Simple but Adequate. S. S. Smith. *Pipe Line Ind. 11,* 64 (1959) Nov. (4 pp.)

Simplicity, economy and purpose are the cornerstones of automatic operations says author. Proper functional approach must be foremost in design of each operation. In the case of pipeline control, there are four separate categories: 1) In station control (analog and digital); 2) pipeline controls (digital); 3) supervisory items (digital, analog or both), and 4) less well defined area of control which takes care of line withdrawals to terminals, which may be entirely automatic-remote or a combination of automatic-remote and local—manual.

Reactors

Backmixing in the Design of Chemical Reactors. O. Levenspiel and K. B. Bischoff. *Ind. Eng. Chem. 51,* 1431 (1959) Dec. (4 pp.)

Role of backmixing in setting design limits for flow chemical reactors is quantitatively determined. The method involves a three-step procedure combining the factors for the intensity of backmixing, reactor geometry, and chemical reaction rate. The intensity of backmixing is measured by the local longitudinal dispersion number, D/ud, which in most cases is simply a function of the Reynolds number. Design charts are presented comparing reactor size with and without backmixing for reactions of various orders involving a single reactant. Perspectives on the importance of backmixing in various types of reactors are considered.

Velocity Profiles in Packed and Fluidized Beds. E. J. Cairns and J. M. Prausnitz. *Ind. Eng. Chem. 51,* 1435 (1959) Dec. (6 pp.)

Data on velocity profiles in packed and fluidized beds are of interest in chemical reactor design. Measurements are reported for velocity profiles of water flowing through 2- and 4-in. packed and fluidized beds, using a tracer technique. Lead and glass particles were used; particle sizes were 1.3, 3.0 and 3.2 mm. Velocity profiles for randomly packed beds and for beds at incipient fluidization are fairly flat. Very small particle-tube diameter ratios also yield flat velocity profiles, regardless of the extent of bed expansion, but as the ratio increases there is a rising deviation from flatness which increases with bed expansion. Denser particles yield flatter velocity profiles.

Retorts

Development and Operation of an Experimental Entrained-Solids, Oil-Shale Retort. H. W. Sohns, E. E. Jukkola and W. I. R. Murphy. *U. S. Bur. Mines Rep. Invest. 5522* (Washington: U. S. Govt. Print. Off., 1959.) (45 pp.)

Retort was constructed in which fine particles of shale, entrained in steam or other gaseous media, could be retorted at controlled temperatures and residence times and the effects of retorting variables upon quality and quantity of products could be determined. Studies of the effects of temperature upon products obtained from Green River (Colo.) and Chattanooga (Tenn.) oil shales were completed. Shale of extremely high moisture content from Brazil also was investigated. Air was used as the entraining medium in a series in which combustion of products within the retort tube supplied a major portion of the process heat. In another series, shale oil from a conventional retort was cracked thermally to obtain data for comparison with results of retorting entrained shale. A study was begun in which the partially retorted shale was recharged to the retort to improve oil yield by recycle retorting. As the retorting temperature was raised, the portion of the

organic matter converted to gas increased, and that converted to oil decreased. Liquid and gaseous products became more dehydrogenated.

Controls

Semi-Automatic Control System for Producing Constant Cooling Rates. L. W. Phipps. *J. Sci. Instruments 36,* 449 (1959) Nov. (4 pp.)

Control system described was designed, and is best suited, for cooling, at a constant rate, the metal sample block of a differential thermal analysis apparatus used for studying supercooling, melting and solidification phenomena in organic materials. An automatically-controlled flow of liquid refrigerant, passing through a simple heat exchanger, is used to cool the primary liquid circulating continuously in the coil system of the block. The apparatus also is suitable for uniform cooling of a small water or oil bath. For either application, controlled cooling rates of up to about 2° C/min are attainable. Using refrigerated water, control is possible from 95° down to about 10° C depending upon the rate, but the range could be extended to lower temperatures by the choice of suitable liquid coolants.

Instruments

Single Pen, Strip Chart Recorder for Unattended Long Period Operation. C. J. Sumner. *J. Sci. Instruments 36,* 475 (1959) Nov. (3 pp.)

Battery-operated recorder is described which is designed for operation for periods of 6-12 months without attention. It is suitable for recording such elements as water depth, rainfull, temperature, etc., and is provided with a solar time-check device which obviates the need for an expensive precision clock. Recording is by a needle-pointed stylus which perforates the chart paper when depressed by a chopper bar. A relatively simple linkage is used to give a rectilinear traverse to the stylus.

Burners

Polymix Gas Burner. C. W. Nieman and J. B. Lawrence (assigned to Bethlehem Apparatus Co., Inc.) U. S. 2,911,035 (1959) Nov. 3.

Improved gas burner is claimed, comprising a tubular casing, an axial air inlet ending in a conical chamber, closed at the front by a perforated plate, a plate with matching perforations forward of the first plate with thin metal tubes filling and connecting the perforations to permit air flow through both, and additional perforations through the forward plate for flow of gas. Thus air and gas pass through the tubes and holes in small laminar streams, unmixed until beyond the forward plate, giving a long silent flame without flashback.

Piping

Pipe Inspection Apparatus. B. G. Price, J. H. Ungar and F. M. Wood (assigned to Tuboscope Co.) U. S. 2,909,393 (1958) Oct. 20.

Invention comprises a device for centering an operating well line-pipe axially within a cylindrical inspection housing, with the pipe intended to move freely through the housing. The centering is achieved by several radial arms, hinged to the housing at one end and with a pipe contact roller at the other end, held by springs against the pipe.

11. MATERIALS OF CONSTRUCTION, AND CORROSION

Cathodic Protection

A Case Study: Cathodic Protection of a Gas Distribution System. E. F. Fowler. *Gas Age 124,* 35 (1959) Nov. 26 (3 pp.)

Northern Illinois Gas Co.'s experience in cathodic protection which encompasses over 200 million feet of main and the service piping off the main. Company has already installed over 50,000 magnesium anodes in sizes 50, 32, 24 and 17 lb, and also has in operation over 100 rectifiers and 17 drainage switches. During the year the company hopes to install 15,000-20,000 more 17 lb magnesium anodes and some 40,000 insulating fittings at the meters. By continuing this method, the entire system should be cathodically protected some day.

The Permanent Anode in Impressed-Current Cathodic Protection Systems—Part 1. C. A. Curtis *Corrosion Tech. 6,* 296 (1959) Oct. (3 pp.)

Radical mitigation of corrosion on external or internal surfaces of pipelines, tank farms, storage tanks, pylon footings and of gasholders, ship's ballast tanks, ship's hulls, condenser end-boxes, heat exchangers and pasturizers, has been successfully accomplished by the application of cathodic protection both by galvanic anodes and by the use of the impressed-current method. The scope of cathodic protection thus is comprehensive. Article describes in a general way the properties, uses and limitations of the principal materials used as anodes in impressed-current cathodic protection systems, together with some indication of the effects of different environments upon the various materials. In this part, graphite, silicone iron and scrap steel are discussed.

Coatings

Applications of Epoxy Resin-Based Coatings in Corrosive Environments. H. Brull. *Corrosion Tech. 6,* 303 (1959) Oct. (5 pp.)

Contribution of epoxy resin-based surface coatings toward reducing the annual cost to the United Kingdom of the effects of corrosion has been appreciated by the paint chemist/technologist, and is being increasingly recognized by engineers, designers and authorities whose task it is to specify special paint systems for protection or decoration. Article surveys the properties and successful applications of these coatings.

Corrosion

Corrosion in a Hydrocarbon Conversion System. F. A. Prange. *Corrosion 15,* 619t (1959) Dec. (3 pp).

Under some inexactly defined conditions, steels and alloys are attacked by atmospheres resulting from oxidation of hydrocarbon. In a fixed-bed catalytic system for dehydrogenation of butane the metal loss which contaminates the catalyst with a fine oxide dust causes undesirable side effects. The way in which the metal loss occurs is described and the effects of alloying agents on both laboratory tests and actual equipment are mentioned. Some examples of metal dusting give a clue to the mechanism of metal loss, but are not complete enough to define it fully.

Partly-Wetted Galvanic Corrosion Couples. P. Hersch. *Corrosion Tech. 6,* 293 (1959) Oct. (3 pp.)

It is well known that the water line along a semi-immersed sheet of metal enhances corrosion by providing easy access for atmospheric oxygen. Thirty years ago U. R. Evans coupled iron, submerged in water or brine, with partly-emerging strips of several metals, and found that copper promoted the rusting more than nickel, and nickel more than lead. This type of corrosion is very frequent and deserves more quantitative consideration, since it is as yet little understood. Thus a recent study of the geometrical conditions leading to corrosion, as aided by a water line, revealed that what is commonly regarded as the effect of the meniscus also depends on a zone of dry metal above it. The present investigation re-examines the role of the partly-immersed metal in conjunction with the electrolyte surrounding.

Preventing Equipment Failure in Sour Gas-Condensate Wells. K. N. Wallam and V. P. Milo. *World Oil 149,* 125 (1959) Nov. (4 pp.)

Two of the major problems in producing sour gas-condensate wells have been the economic and personnel hazards caused by spontaneous failure of well equipment. Hydrogen sulfide stress corrosion cracking has been responsible for these failures. Shell Oil Company has reduced the probability of such failures to a minimum by determining the corrosivity of each new well stream and is using this information to select proper resistant equipment and appropriate completion practices.

Underground Corrosion and Methods of Control. Part I. O. C. Mudd. *Pipeline Eng. 31,* D-30 (1959) Dec. (3 pp.)

Deterioration signs on above ground structures are usually detected by visual inspection, but those buried below ground or included in structures where access is difficult or impractical may entail prohibitive costs in inspection attempts. Hence, it is essential that adequate measures be included in design of such inaccessible structures, or their components, to minimize impairment and failure. Underground structure impairment or failure predominately occurs from external soil corrosion when adequate preventive measures are not applied. The electrochemical theory of corrosion is discussed in detail and is used in brief exposition of pipeline corrosion.

Metals

Low Temperature Characteristics of Metals. O. A. Hansen. *Refining Eng. 31,* C-21 (1959) Dec. (4 pp.)

Characteristics of all materials of construction are affected by temperature, and it is part of the work of the engineer to select those materials suitable for the conditions of operation. But, reliability of the complete apparatus depends upon more than proper material. Treatment of that material before fabrication, methods of fabrication, and test procedure all leave a marked effect on the finished article. Unusual problems are created by low temperature operation. Article discusses some of the common metals and methods of fabrication used to combat this problem.

Metals Controlled by Service Stresses. E. H. Bucknall. *Refining Eng. 31,* C-33 (1959) Dec. (6 pp.)

Metals and alloys should be selected to adequately resist, at all stages of service, the stresses which arise from plant pressure and other sources. The refining and petrochemical industry has little or no use for materials which do not have attractive properties on a long-term basis, which eliminates most of the newer high-temperature materials. Author discusses the more serious potential sources of fracture and names several metallurgical process developments from which the petroleum refining industry should profit.

Piping

ASTM A426-58T Alloy Steel Centrifugally Cast Pipe. H. Thielsch. *Refining Eng. 31,* C-8 (1959) Dec. (6 pp.)

Specification ASTM A426-58T, written by the Task Force of the American Society for Testing Materials

(ASTM), covers carbon-molybdenum and chromium-molybdenum steel grades. Although prepared for a type of cast material, the chemical and mechanical requirements were based on the requirements of other applicable ASTM high-temperature specifications covering wrought piping grades, such as A335 (wrought seamless pipe) or A369 (forged and bored pipe) rather than the corresponding ASTM specification applicable to sand cast grades as A217 (alloy steel castings as valves, flanges, fittings, etc.). For example, the chemical requirements in the proposed specification are the same as in A335. The identifying numbers tentatively assigned correspond to those used in the piping specifications.

For Piping Design "Outside Battery Limits" . . . API 5LX High-Test Line Pipe. G. M. Haydel. *Refining Eng. 31,* C-16 (1959) Dec. (3 pp.)

ASA Standard B31.3-1959 "Petroleum Refinery Piping" permits the use of API 5LX pipe in the X42, X46 and X52 grades in refinery work except for highly flammable or toxic materials within the process unit limits. Design conditions and criteria including allowable stresses for the X grade materials are listed in the ASA Standard. However, their use is not recommended under conditions where metal temperatures in excess of 300° F are encountered. A summary of recommended allowable stresses is included in tabular form. These are compared with similar allowable stresses for the A106 and A53 pipe.

Plastics

Plastics for Corrosion Protection in the Chemical Industry. A. R. Gabel and H. W. Schmidt. *Chem. Eng. Progress 55,* 39 (1959) Nov. (3 pp.)

There is evidence that the U. S. is fast realizing the advantages to be gained by the use of organics over metals in many fields. For example, the acquisition of plastic pipe producing facilities by large steel producers indicates that there is a growing demand for nonconventional materials. The Society of the Plastics Industry has done much toward establishing specifications and data that will allow the selection of the right material for a specific job, but it will be several years before standardization is accomplished. This means that considerable working knowledge of plastics is necessary to select the material best suited for the job.

Plastic Piping Systems. H. E. Atkinson. *Chem. Eng. Progress 55,* 56 (1959) Nov. (3 pp.)

In considering requirements for plastic pipe, it must be remembered that a piping system includes pipe, joints, fittings, flanges and valves. For economy, all components must be available in compatible dimensions to provide maximum strength and minimum labor for assembly. It is against this basic concept that materials must be compared. Materials considered are: Unplasticized polyvinyl chloride (PVC), Type I, normal impact and Type II, high impact; acrylonitrilebutadiene-styrene copolymers and blends (ABS); polyethylene, branched and linear; epoxy resin, glass reinforced; saran-lined steel, and steel lined with extruded TFE fluorocarbon resin.

12. ANALYTICAL METHODS AND TESTS

Chromatography

Correlation of Gas Chromatography and Extractive Distillation. G. W. Warren, R. R. Warren and V. A. Yarborough. *Ind. Eng. Chem. 51,* 1475 (1959) Dec. (2 pp.)

Previous investigators have compared gas chromatographic separations to those obtained by conventional distillations. Gas chromatographic separations can be correlated only with extractive distillation separations. The ratio of partition coefficients obtained from the chromatographic data is compared to relative volatilities obtained from equilibrium still data.

Determination of Dissolved Gases in Petroleum Fractions by Gas Chromatography. J. A. Petrocelli and D. H. Lichtenfels. *Anal. Chem. 31,* 2017 (1959) Dec. (3 pp.)

Gas chromatographic procedure has been developed for the determination of dissolved gases, especially oxygen and nitrogen, in petroleum fractions. The essential feature of this method involves the use of a precolumn or trapping column in series with a molecular sieve column. The hydrocarbons are retained in the precolumn and the oxygen and nitrogen are resolved in the molecular sieve column. This method is applicable for determining these dissolved gases in petroleum fractions up through the lubricating oil range. It also has been applied experimentally to other similar analytical problems.

The Potentialities of Coated Capillary Columns for Gas Chromatography in the Petroleum Industry. D. H. Desty, A. Goldup and B. H. F. Whyman. *J. Inst. Petrol. 45,* 287 (1959) Sept. (12 pp.)

Application in the petroleum industry of the coated capillary columns recently described by Golay and Dijkstra has been examined. In conjunction with the new sensitive ionization detectors they enable very high separation efficiencies to be attained and offer the possibility of much reduced time of analysis. A complete apparatus operable up to 250° C incorporating a flame ionization detector and a novel sample introduction system for both gaseous and liquid samples has been developed. Results obtained with a variety of petroleum products from gases to high-

boiling liquids are described and used to illustrate the potential uses of these columns in the petroleum industry. Some considerations have been given to the theory of coated capillary columns and the Golay and van Deemter equations for the height equivalent to a theoretical plate are compared.

Separation of C_4 and Lighter Hydrocarbons by Gas-Liquid Chromatography. T. A. McKenna, Jr. and J. A. Idleman. *Anal. Chem. 31,* 2000 (1959) Dec. (4 pp.)

Accuracy of chromatographic peak area measurements of concentration is enhanced by completely separating the peaks. This investigation was designed to screen available liquids suitable for columns and to select the optimum solid support. A combination of liquid and solid has been found such that the normally encountered hydrocarbons through C_4 are all separated within the $\pm 3\sigma$ limit of the normal error curve, or 99.7 area % at room temperature. Methods for selecting the liquid and solid are described.

Emission Spectrograph

A Comparison of Carbon and Graphite Electrodes. J. W. Mellichamp and J. J. Finnegan. *Appl. Spectroscopy 13,* 126 (1959) Oct. (5 pp.)

Electrode material in which the sample is excited is an important factor in spectrochemical analysis. While physical differences between carbon and graphite electrodes are found to be slight, a difference in consumption rates in a direct-current arc is observed. Thermal conductivity of the electrode material produces a temperature gradient which, along with arc conditions, determines electrode consumption rates. Selective volatilization of impurity elements as well as intensities of impurity spectral lines are modified by changes in consumption rates.

Spectroscopic Studies of Trapped Radicals. *Appl. Spectroscopy 13,* 124 (1959) Oct. (3 pp.)

Spectroscopic studies were conducted of the light emission from a variety of free radical species produced in the excitation of nitrogen, oxygen and other condensates by the National Bureau of Standards. Two methods of free radical production were employed to provide an understanding of free radical behavior, a subject which currently is receiving attention throughout Government and industry.

LPG

Product Tests the Average Dealer Can Use. E. R. Biggins. *Butane-Propane News 21,* 35 (1959) Dec. (5 pp.)

Ten major product tests and checks give Pyrofax Corp. a good indication of the quality of the propane that comes to and goes from their 115 plants. The two most important tests and checks are those for detecting high moisture content and hydrogen sulfide. In addition to these two tests, the company also tests or checks for: Presence of sufficient or excessive odorant, excessive amounts of higher or lower boiling compounds, oil contamination, accuracy of scales, cylinder weight, proper filling of cylinders and valve and fuse plug leakage.

Particle Size

Accurate Particle Size Distribution with Electroformed Sieves. R. R. Irani and C. F. Callis. *Anal. Chem. 31,* 2026 (1959) Dec. (3 pp.)

Method is described for calibrating sieves. Particle size distributions in the range of 10-100 mu can be determined with calibrated electroformed sieves with accuracies at the 95% confidence limits of ± 9.4 and $\pm 9.2\%$ for the geometric mean diameter and geometric standard deviation, respectively. The corresponding precision is ± 2.6 and $\pm 6\%$, respectively.

Spectography

Sample Flow Rate. A Critical Parameter of Spectral Excitation in Cyanogen- and Hydrogen-Oxygen Flames. K. Fuwa, R. E. Thiers, B. L. Vallee and M. R. Baker. *Anal. Chem. 31,* 2039 (1959) Dec. (5 pp.)

When an aqueous solution is aspirated into a flame, the intensity of the spectral lines of the sample elements is a nonlinear function of the flow rate of the aspirated solution. For each spectral line an optimal flow rate exists at which the line intensity is a maximum, decreasing at both higher and lower flow rates. This characteristic was predicted theoretically on the basis of the cooling effect of the aqueous solution upon the flame. This phenomenon has now been observed experimentally, in quantitative agreement with the theory. The flow rate at which the maximum intensity occurs is a function of the excitation potential of the line being measured and of the inherent temperature of the flame. The optimal flow rate decreases with increasing flame temperature and excitation potential of the line measured. The cyanogen-oxygen flame (4850° K) shows such intensity optima at flow rates of sample near 60 μl/min, an extremely low value. These considerations are of crucial importance in the utilization of high temperature flames as sources for spectrochemical analysis, and optimal flow rates must be ascertained and exploited for maximum sensitivity of detection to be attained.

Tars

The Determination of Tar Acids and Tar Bases in Light Coal-Tar Distillates. G. E. Mapstone and A. T. Keppie. *Chem. & Ind.* 1397 (1959) Nov. 7 (3 pp.)

Evaluation of a light oil of coal-tar origin includes the determination of the tar acid and tar base contents. The normal sequence of carrying out these determinations is to extract the phenols with sodium hydroxide solution followed by the extraction of the basis with acid. However, a portion of the bases dissolve in the sodium phenate extract and so are lost to the standard determination while the presence of ammonia or of ammonia-generating materials in the oil can give high figures for the tar base content. By suitable modifications to the Standard Methods for Testing Tar and its Products these interferences can be overcome, according to authors who propose such modifications.

Water

Determination of Water by Direct Amperometric Measurement. F. A. Keidel. *Anal Chem. 31,* 2043 (1959) Dec. (6 pp.)

Method of measuring water, based on quantitative electrolysis in a specially designed cell, has been developed. While especially applicable to measurement of water in gases at concentrations less than 1 ppm by volume up to about 1000 ppm, higher concentrations can easily be measured. Many liquids can be analyzed after vaporization. Other liquids and many solids can be analyzed by stripping with an inert gas. Analysis of inert gas supplies, gas and liquid process streams, and solid materials, and the measurement of film permeabilities are a few of its applications. Article discusses some of these in detail.

A Method for the Determination of Trace Amounts of Water in Hydrocarbons. A. F. Pyrah and R. S. Robertson. *J. Inst. Petrol. 45,* 316 (1959) Oct. (4 pp.)

Method described involves simple equipment which can be made up in any industrial laboratory, is reasonably fast, and enables water contents within the range of 0-100 ppm to be determined on a 20-ml sample of mercaptan-free hydrocarbons, with a repeatability of 2-4 ppm. The accuracy of the method depends primarily on the sensitivity of the end point detector. At the end point, however, a slight excess of reagent depolarizes the electrodes and current flows, causing a drop in potential across the electrodes. The end point can thereby be detected by noting when an increase in current or a drop in voltage occurs. In this way the addition of as little as 0.01 ml of Karl Fischer reagent (equivalent to 0.03 mg of water) could be detected, and the results obtained were in stoichiometric proportion to the amount of water added.

13. BASIC SCIENCE

Adsorption

Adsorption on Microporous Barriers. L. O. Rutz, J. B. Graham and K. Kammermeyer. *J. Chem. Eng. Data 4,* 307 (1959) Oct. (4 pp.)

Adsorbed or condensed flow of gases and vapors permeating through microporous media has been linked to the adsorptive properties of the barrier. Recently, the barrier separation of gas mixtures of carbon dioxide and propane was described strictly on the basis of adsorbed flow. In this system, separation due to diffusive molecular flow should have been essentially nil, because the molecular weights of these gases (or vapors) are almost identical. The solid adsorbent used was Vycor porous glass, whose physical properties have been reported. The gases and vapors were hydrogen, nitrogen, argon, carbon dioxide, methane, ethene, propane, propene, *n*-butane, and 1-butene.

Chemisorption

Quantitative Aspects of the Changes in the Electrical Conductivity of Metals Due to Chemisorption. P. Zwietering, H. L. T. Koks and C. van Heerden. *J. Phys. and Chem. of Solids 11,* 18 (1959) Nov. (8 pp.)

Measurements of the change in electrical conductivity of evaporated metal films caused by chemisorption on the surface are described. The quantitative results have made it possible to draw certain conclusions as to the effective valency of the metal surface atoms and the number of bonds formed for each adsorbed molecule. These conclusions are in agreement with the information obtained from the total number of adsorbed molecules per cm^2 of true surface area at full coverage. In agreement with the experimental results of other investigators, a change in bond type for hydrogen on iron and nickel at higher coverages is found.

Equation of State

How to Predict PVT Relations. W. R. Gambill. *Chem. Eng. 66,* 195 (1959) Oct. 19 (7 pp.)

Equations of state and compressibility factor charts that apply to gases are reviewed. Vapor pressure correlations also are given and normal boiling point is estimated from PVT.

Volumetric Behavior and Critical Constants of Isopentane. S. P. Vohra and K. A. Kobe, *J. Chem. Eng. Data 4,* 329 (1959) Oct. (2 pp.)

Serious disagreement in the volumetric properties of isopentane arose between the results of Issac, Li and Canjar and those of Silberberg, McKetta and Kobe (see *Gas Abstracts 15,* 327). Deviations in the re-

gions covered by both investigators ranged from 4.0-6.2%. Values obtained by both groups differ from the work of Young in 1894. The work of Issac, Li and Canjar was done in a variable-volume apparatus while that of Silberberg, McKetta and Kobe was done in a Burnett apparatus. It was considered desirable to repeat the work in a variable volume apparatus. Because the critical constants have not been checked since the work of Young in 1910, they also were determined.

Fluidization

Gas-Solids Contacting in Fluidized Beds. K. P. Lanneau. *Petrol. 22,* 401 (1959) Nov. (2 pp.)

Treatment of the problem of gas solids contacting in fluids beds emphasizes the importance of considering this aspect of the fluidization technique in process applications. Capacitance probe studies were conducted over a wide range of fluidizing gas velocities, 0-5 ft/sec. This covers the entire range from the point of incipient fluidization to the high velocity level where solids are rapidly transported from the bed, and the conditions of solids transfer line operation are approached.

Heat Transfer

Heating and Cooling Air and Carbon Dioxide in the Thermal Entrance Region of a Circular Duct with Large Gas to Wall Temperature Differences. H. Wolf. *J. Heat Transfer 81,* 267 (1959) Nov. (13 pp.)

Local heat transfer characteristics for air and carbon dioxide in the thermal entrance region have been determined experimentally and are compared with predicted values computed from an extension of the theoretical analysis due to Deissler. The experiments were conducted in smooth round tubes having a fully developed turbulent velocity profile and a uniform temperature distribution at the entrance. The boundary conditions of uniform heat flux for heating the gas and wall temperature constant and variable with axial distance for cooling the gas were investigated with large temperature differences between the gas and the tube wall. For heating, the experimental results yielded 1% thermal entrance lengths ranging from 11-27 diam over the bulk Reynolds number range from 50,000-246,000. For cooling, 1% thermal entrance lengths ranging from 12-26 diam were obtained for bulk Reynolds numbers ranging from 17,000-218,000. The agreement between theory and experiment was favorable in most cases.

Heat and Mass Transfer Analogy . . . An Appraisal Using Plant Scale Data. J. F. Revilock, H. Z. Hurlburt, D. R. Brake, E. G. Lang and D. Q. Kern. *Chem. Eng. Progress 55,* 40 (1959) Oct. (5 pp.)

Colburn and Hougen analysis established for designing apparatus to condense vapor from vapor-noncondensable gas mixtures – equipment having small inlet concentrations of condensables — is also applicable to partial condensers and dephlegmators. The computer reduces the importance of time as a consideration in any of the methods. Based on the modification of Kern, Franks and O'Brien have published a program for an analog computer which requires but a few seconds for a complete solution. Digital computer programs currently also are in use. No article, however, has ever verified the precision of the analogy in a large-scale application. Article tries to supply the results of such a study and to contribute to the appraisal of the analog and its applicability to industrial design.

Heat Transfer to Water, Oxygen and Carbon Dioxide in the Near Critical Region. M. E. Shitzman. *Teploenergetika,* 68 (1959) Jan. (4 pp. Russian text.) (From *Appl. Mech. Rev. 12,* 718 (1959) Oct.)

Comparison is given between an earlier method of heat transfer calculation in the near critical region and the new data derived from the experiments with water, liquid oxygen and carbon dioxide.

From author's summary

Turbulent Flow in a Circular Tube with Arbitrary Internal Heat Sources and Wall Heat Transfer. R. Siegel and E. M. Sparrow. *J. Heat Transfer 81,* 280 (1959) Nov. (11 pp.)

Analysis has been carried out to determine the heat transfer characteristics for turbulent flow of a heat generating fluid in a circular tube with wall heat transfer. The internal heat generation is uniform over the tube cross section, but may very longitudinally in an arbitrary manner. The wall heat transfer may also vary in an arbitrary way in the longitudinal direction. The analysis applies along the entire length of the tube, that is, in thermal entrance was well as fully developed regions. The fluid is assumed to have a fully developed turbulent velocity profile throughout the length of the pipe. Numerical results are presented for fluids with Prandtl number ranging from 0.7-100 for Reynolds numbers from 50,000-500,000. The extension of the results to include radial heat source variations is included.

The Use of Thin Films for Increasing Evaporation and Condensation Rates in Process Equipment. E. L. Lustenader, R. Richter and F. J. Neugebauer. *J. Heat Transfer 81,* 297 (1959) Nov. (11 pp.)

Article describes an experimental investigation of an evaporating and condensing test apparatus in which over-all heat transfer coefficients as high as 8000 Btu/(hr) (sq ft) (° F) were obtained wtih water

by utilizing thin films both in evaporation and condensation. The films were obtained by wiping on the evaporating surface and utilizing surface tension effects on the condensing surface. The phenomena on both the evaporating and the condensing surfaces are amenable to theory.

Helium

Thermodynamic Properties of Helium at Low Temperatures and High Pressures. D. B. Mann and R. B. Stewart. *J. Heat Transfer 81,* 323 (1959) Nov. (4 pp.)

Thermodynamic properties of helium have been compiled and correlated for a temperature range from 3.0-20° K for pressures to 100 atm and for specific volumes from 5-800 l/kg. The properties are presented on both the temperature-entropy and the enthalpy-entropy coordinate systems and include pressure, temperature, volume, entropy and enthalpy.

Hydrocarbons

Applied Hydrocarbon Thermodynamics. Part 15a. Flash Vaporization Conditions from Terminal Volatilities. W. C. Edmister. *Petrol. Refiner 38,* 125 (1959) Dec. (8 pp.)

Integral technique for making equilibrium vaporization calculations for petroleum fractions was described and illustrated previously. This calculation can be made for multicomponent curves having TBP curves of any shape. The number of points required for these calculations depends upon the nature of the mixture being distilled. The ultimate in simplification of the TBP curve and the calculations based upon it is the use of two points on coordinates that permit representing the TBP curve as a straight line. Such a simplification is made in this installment and used as the basis for developing analytical solutions from which charts are prepared for equilibrium flash vaporization.

Hydrogenation

Medium Effects in the Homogeneous Catalytic Activation of Molecular Hydrogen by Metal Salts. A. J. Chalk and J. Halpern. Part 1. **Cupric and Cuprous Heptanoates in Heptanoic Acid.** *J. Amer. Chem. Soc. 81,* 5846 (1959) Nov. 20 (7 pp.); Part 2. **Anion and Solvent Effects for Cupric and Cuprous Salts.** *Ibid.,* 5852 (1959) Nov. 20 (3 pp.); . . . and A. C. Harkness. Part 3. **Silver and Mercuric Salts.** *Ibid.,* 5854 (1959) Nov. 20 (4 pp.)

Article describes, in Part 1, a kinetic study of the hydrogenation of cupric heptanoate in heptanoic acid solution. Since heptanoic acid is one of the products of the reaction, its choice as solvent minimizes complications such as have been encountered in earlier related studies, due to medium changes as reaction proceeds. The results are reported in some detail since they differ significantly from those for both solvent systems examined earlier. Part 2 describes further measurements on the hydrogen reduction of cupric salts in nonpolar media. Earlier studies on cupric heptanoate in heptanoic acid have been extended to other solvents and to cupric salts of other organic acids. Kinetic studies of the homogeneous reduction, by molecular hydrogen, of silver and mercuric heptanoates in heptanoic acid and biphenyl solution are described in Part 3 of this series.

Methane

Diffusion Coefficients in Hydrocarbon Systems. Methane in the Liquid Phase of the Methane-Cyclohexane System. H. H. Reamer and B. H. Sage. *J. Chem. Eng. Data 4,* 296 (1959) Oct. (5 pp.)

Molecular transport studies of the lighter paraffins in hydrocarbon mixtures were initiated by Pomeroy and Lacey. These data recently have been supplemented by investigations of several binary paraffin hydrocarbon systems at elevated pressures. These studies indicate a rather systematic variation in the molecular transport characteristics of methane with an increase in molecular weight of the less volatile component. Furthermore, the Fich diffusion coefficient is markedly influenced by temperature and pressure, particularly near the critical state of the binary system in question. No data on the molecular transport of the paraffin hydrocarbons in the liquid phase of binary systems containing a cyclic compound were available, so methane in the liquid phase of the methane-cyclohexane system was investigated at pressures up to with 500 psi of the critical states of the system for the temperature interval between 100-280° F.

Shock Tube Studies on the Pyrolysis and Oxidation of Methane. G. B. Skinner and R. A. Ruehrwein. *J. Phys. Chem. 63,* 1736 (1959) Oct. (7 pp.)

Shock tube has been used to study the pyrolysis and oxidation of methane in the range 1200-1800° K under homogeneous reaction conditions. The experimental activation energy in pyrolysis is 101,000 cal, which suggests that the initiating reaction is $CH_4 \rightarrow CH_3 + H$, and that the chain length in reaction is only 2. With addition of oxygen, the activation energy decreases, suggesting that the initiating reaction is $CH_4 + O_2 \rightarrow CH_3 + HO_2$. Quantitative product yields of C_2H_6, C_2H_4, C_2H_2 and H_2 are recorded for pyrolysis experiments, and these plus CO for oxidation experiments. Induction times were measured for several CH_4–O_2 mixtures of 40% or less O_2 content, in the range of 1-10 msec.

Phase Equilibria

Phase Behavior in the Nitrogen-Ammonia System. H. H. Reamer and B. H. Sage. *J. Chem Eng. Data 4,* 303 (1959) Oct. (3 pp.)

Volumetric and phase behavior of nitrogen and of ammonia has been studied in sufficient detail for the purpose of an investigation of phase behavior in the nitrogen-ammonia system. A detailed study was made of the volumetric behavior of nitrogen in the gas phase. The volumetric and phase behavior of ammonia has been described and the results are available also in tabular form. The solubility of nitrogen in ammonia was carefully investigated as part of a general study of the volumetric behavior of the nitrogen-ammonia system in the liquid phase; for this binary system, the data establish with reasonable accuracy the composition of the bubble point liquid as a function of pressure and temperature.

Thermodynamics

Entropy Change During Relaxation of a Gas Behind a Shock Wave. I. P. Lun'kin. *Soviet Phys.-JETP 7,* 1053 (1958) Dec. (3 pp.); Trans. of *Zh. Eksp. Theor. Fiz. 34,* (1958) June (5 pp.), by Amer. Inst. of Phys., Inc., New York; (From *Appl. Mech. Rev. 12,* 635 (1959) Sept.)

Investigation is made of entropy changes which take place in shock waves as translational, rotational and vibrational degrees of freedom are successively excited and as dissociation is induced. It is shown that the largest entropy change takes place when the translational degrees of freedom are excited; excitation of other degrees of freedom involves smaller entropy variations.

From author's summary by E. W. Price, USA

Saturated Liquid Phase Enthalpies at High Pressures. Ethane—*n*-Heptane System. J. H. Weber. *J. Chem. Eng. Data 4,* 301 (1959) Oct. (2 pp.)

As part of a continuing study of thermal data of binary systems, saturated liquid phase enthalpies are presented for the system ethane—*n*-heptane at 100, 200, 300, 400, 500 and 600 psia. Saturated liquid phase enthalpy data have been presented for other hydrocarbon systems. The method used for calculating the saturated liquid enthalpy data is outlined by Dodge and has been discussed in detail.

Thiophene

Pyrolysis of Thiophene. H. Wynberg and A. Bantjes. *J. Organic Chem. 24,* 1421 (1959) Oct. (3 pp.)

Pyrolysis of thiophene at 850° yields a mixture of three isomeric bithiophenes in 7-8% conversion. Mass spectral analysis of the pyrolyzate furnishes evidence for the occurrence of a variety of additional condensation products.

Ultrasonics

Current Trends in Ultrasonics. S. R. Rich. *Ind. Laboratories 10,* 5 (1959) Dec. (7 pp.)

Many industrial processes have been improved or completely altered by the use of ultrasonic energy. New ultrasonic instruments today measure a variety of quantities rapidly and conveniently. These include flow, viscosity, elastic modulus, liquid level, film thickness and many others. New transducer materials and ways of utilizing them have been a key factor in major industrial transformation.

Hydrogen

Process for Recovering Heavy Hydrogen and Heavy Water. J. Hoogschagen (assigned to Stamicarbon N. V.) U. S. 2,908,554 (1959) Oct. 13.

Heavy hydrogen and heavy water are recovered from natural water by continuously feeding water into a circulating stream of hydrogen under pressure, catalytically transferring the deuterium to the hydrogen stream and separating this enriched stream, cooling and rectifying to recover the bottoms product of enriched deuterium. Multiple steps of transfer and rectification can be used to increase concentration.

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ASHRAE J.
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Brennstoff-Chemie (German)
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Business Week
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California Oil World
Canadian Chemical Processing
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4. *To stimulate and correlate research within the Gas Industry.*

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